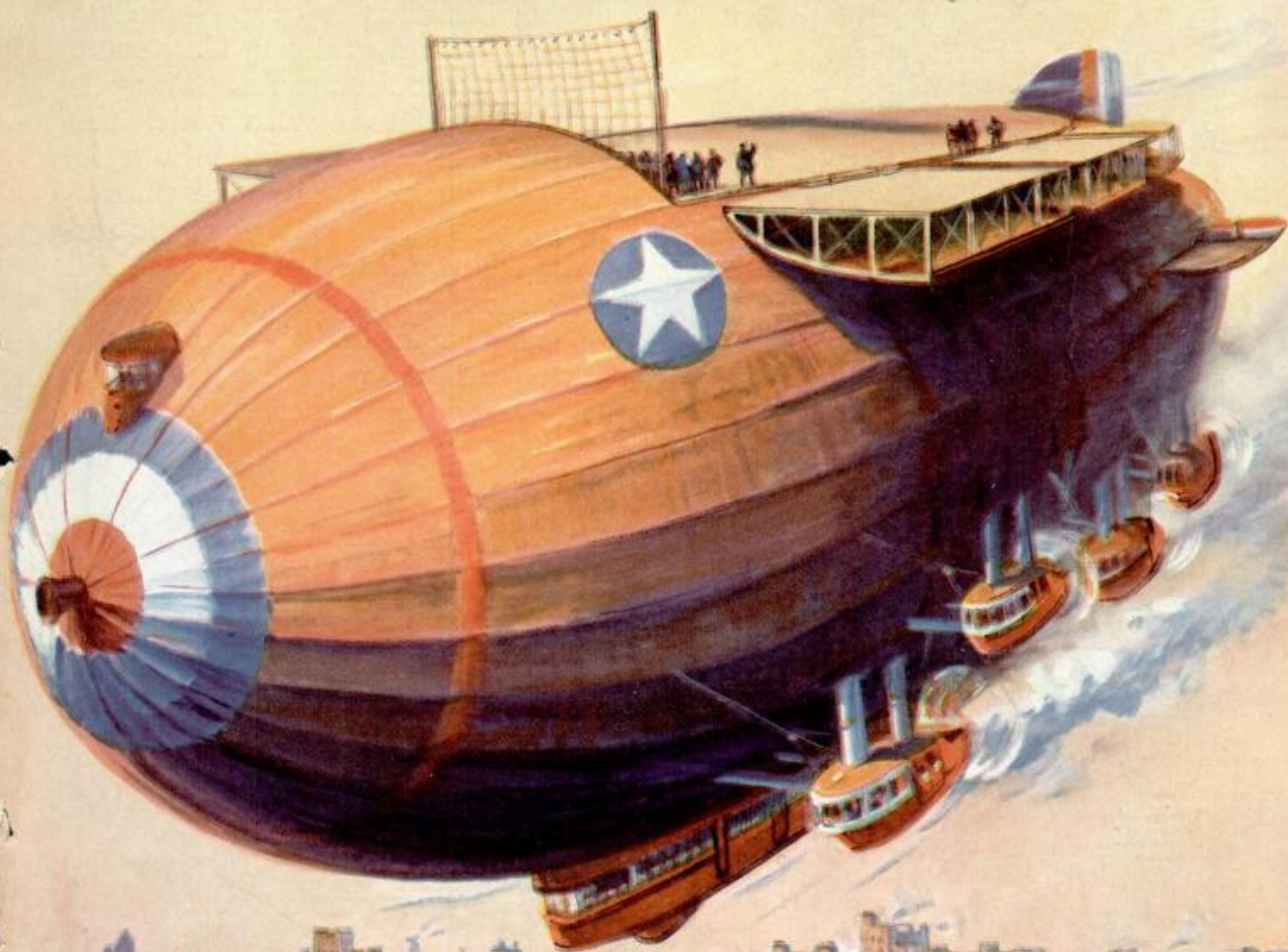


Popular Science

FOUNDED **MONTHLY** 1872





This symbol
of quality
is your pro-
tection

Radiola Grand and Mahog-
any Stand with "B" bat-
teries and 4 Radiotron WD-
11 dry cell vacuum tubes
\$350.00

Radiola Grand

WITH the Radiola Grand, radio takes on new mean-
ing. The simplicity of tuning in
—just a knob or two to turn. The
big distances it covers—picking
up far-away stations with volume
enough to fill a room. The per-
fection of tone with which the
loudspeaker—carefully built in
like the horn of a fine phono-
graph—gives forth the music and
speech. All this—combined in a
cabinet of skillful workmanship
and tasteful design—places radio
in the home where beauty counts
—and performance.

Points to Note:

All the batteries — dry cells — are
hidden away inside.

You can regulate the volume of
sound by a control that governs the
loudspeaker.

For long distance, plug in the head-
phones. Coast to coast reception
is no unusual record for Radiola
Grand!

Famous for true reception, undis-
torted. For keen sensitivity. And
for beauty.

"There's a Radiola for every purse"

at the nearest Radio or Electrical Store

Radio Corporation of America

Sales Department
233 Broadway
New York

District Sales Offices
10 So. LaSalle Street Chicago, Illinois
433 California Street San Francisco, California

RADIO CORPORATION OF AMERICA
Dept. 2080. Address office nearest you.
Please send me your free Radio Booklet.

Name _____

Street Address _____

City _____ R. F. D. _____

State _____

Radiola

REG. U. S. PAT. OFF.

See Here!

You can make
\$75 to \$125
a week!

NOW You Can Learn AT HOME!



Your Name HERE!

A business of your own, paying \$3,000 to \$10,000 a year in profits! Cooke-trained Experts have gone into business with little or no capital and have found their future and their fortune repairing Automobiles, Trucks, Tractors, Gas Engines. You can, too!



B. W. COOKE
President Cooke Auto School
"greatest institution of its kind in the world."

At last! you can become an auto, truck and tractor expert right in your own home with our practical, "Job-Way" training. If you like machinery, if you want to get ahead, here is the quickest road to BIG PAY! In what other way can you trade your spare time right at home for TRAINING that will prepare you to go into business or take your choice of a hundred jobs paying \$75 to \$125 a Week! Good jobs everywhere! In garages, repair shops, service-stations, factories. As Salesman, demonstrators, electrical experts, Master Mechanics. In Battery stations, Vulcanizing Shops, Welding plants or in business for yourself. Salaries sky-high, easy hours, and opportunities for a business of your own all around you! Man alive! You cannot afford to hesitate a minute!

Learn Auto Mechanics Electricity, Tires, Welding, Battery

Now 15 million autos, trucks and tractors crowding the cities, highways and farms. 15,000,000 electrical systems to maintain and repair, 50 million tires to replace and repair, 15 million batteries to test and service, 15 million autos, trucks and tractors to keep going! Do you realize that COOKE "JOB-WAY" training prepares you right at home for the opportunity—that when you're EXPERT you don't need "luck" or an "opportunity"—they're right here NOW waiting for you to start and finish!

Be an Auto-Tractor-EXPERT!

Start NOW!

Men Wanted!

I train you to hold down these big-pay Jobs:

MASTER MECHANICS	\$3000 to \$8000
ELECTRICAL EXPERTS	\$3600 up
GARAGE MANAGER	\$3000 up
TRACTOR ENGINEER	\$2400 up
SALESMAN	\$3000 to \$12000
EXPERT WELDER	\$2400 up
BATTERY EXPERT	\$2400 up

I'll help you start and help you finish. Inducements you cannot resist, RIGHT NOW to ambitious men; terms within reach of everybody! Free Employment Service to help you get the job you want at top pay! Many extras, but not one penny extra for anything. Find out how easy I have made it for you to SUCCEED thru my SUCCESS coupon.

Mail Coupon TODAY!

RADIO COURSE FREE! This Month

Only one of the many surprises waiting for the man who has "gumption" enough to write for my big offer right away! Without one cent of cost, I am giving away a limited number of these \$45 courses. Why not get one? SUCCESS Coupon entitles you to this money-making course Free!

B. W. COOKE, President
Cooke Auto School
Dept. 106,
500 S. Throop St., Chicago

**COOKE
AUTO
SCHOOL**

SUCCESS COUPON

B. W. COOKE, President
Cooke Auto School, Dept. 106, 500 S. Throop St., Chicago
Please send me Free Book and complete information about your Home Study Course. I am mailing this promptly to secure FREE RADIO COURSE, FREE REPAIR KIT and the reduced prices and special terms you offer now. Of course, I am not obligating myself in any way.

Name
St. No. or R.F.D.
City..... State

LEARN WITH TOOLS



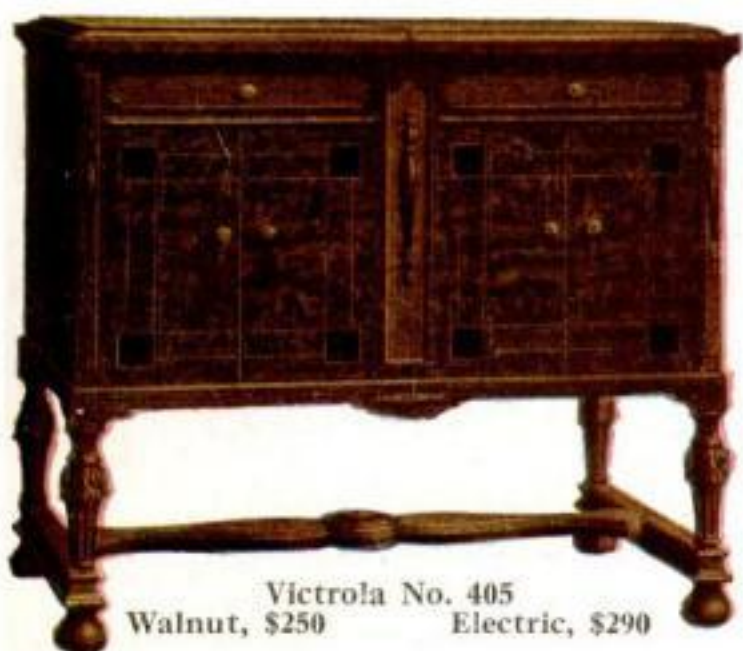
\$18.50 Repair Kit FREE

No books or useless theory in my home study "JOB-WAY" Course. This \$18.50 repair kit only one of many inducements offered to get you started on the road to success NOW! Mail coupon for complete information, learn how you can MAKE MONEY almost from the start with this outfit.

Three new Victrola models



Victrola No. 400
Mahogany, \$250 Electric, \$290



Victrola No. 405
Walnut, \$250 Electric, \$290



Victrola No. 410
Mahogany, \$300 Electric, \$340

The three new Victrola models illustrated herewith incorporate Victrola musical quality in cabinets reflecting all the skill of the master designers of other generations—a perfect combination of art and utility with moderate cost, resulting from our unequalled facilities and long experience.

Fully equipped with albums, Victrola No. 2 sound-box, new improved Victor tapering tone-arm and goose-neck sound-box tube, full-floating amplifier, speed indicator and the simple, reliable Victor motor.

Built entirely in the Victor factories, which are the largest devoted entirely to the production of one musical product.

In buying a talking-machine consider that you must choose the Victrola or something you hope will do as well and remember that the Victrola—the standard by which all are judged—costs no more.

A selected list of Victor Records illustrating Victor quality

Lucia—Sextet	Galli-Curci, Egner, Caruso,		
	de Luca, Journet, Bada	95212	\$3.50
Berceuse from Jocelyn	McCormack and Kreisler	89106	2.00
Elegie—Mélodie	Caruso and Elman	89066	2.00
Song of the Volga Boatmen	Chaliapin	88663	1.75
Whispering Hope	Gluck and Homer	87524	1.50
Ave Maria (Schubert)	Heifetz	74563	1.75
Minuet in G (Paderewski)	Paderewski	74533	1.75
La Capinera (The Wren)	Galli-Curci	64792	1.25
Traviata—Prelude	Victor Symphony Orchestra	35717	1.25
Waltz of the Flowers			
National Emblem March	U. S. Marine Band	18498	.75
Lights Out March	Arthur Pryor's Band		



Victrola

Look under the lid and on the labels for these Victor trade-marks
Victor Talking Machine Company, Camden, N. J.

These Bas-Relief Lincoln Book-Ends are of a heavy beautiful, bronzed metal; they would sell in any store for at least \$1.00; in most stores for \$1.25 or \$1.50. Read below how you may obtain a pair for nothing.



Free—this pair of Lincoln Bas-Relief Book-Ends an offer that can never be made again

An amazingly liberal introductory offer on a new set of thirty world's masterpieces. Read below why it is made.

YOU have heard of Little Leather Library books. There are few good homes in the country where these beautiful little volumes cannot be found. Over 20,000,000 were sold prior to 1923. Now, a new set of thirty of the world's greatest masterpieces has been published in this edition at a price of only \$2.98 for all thirty volumes.

From past experience the publishers know that, as soon as this new set is fairly well distributed in representative American homes, it will become as universally popular as their previous books. To have a few thousand sets distributed quickly, this unprecedented offer is made to readers of *Popular Science Monthly*.

Can you afford not to take advantage of it? Here are thirty beautifully bound volumes, books that every intelligent person wants to own, sold at the amazingly low price of only \$2.98 for all thirty; and, in addition, this handsome pair of bronzed metal Lincoln Book-Ends, worth from \$1.00 to \$1.50, but given to you free.

Thirty Books for the Price of One

The books themselves are works that no person, mindful of his friends, would care to confess he is not familiar with. They are complete masterpieces, in some cases more than one, of such immortal authors as:

Barrie	Allen	Dumas
Kipling	Balzac	Emerson
Shaw	Browning	Whitman

\$5000.00 in Cash Prizes

TO FURTHER acquaint the public with the contents of these wonderful masterpieces, a unique prize contest has been inaugurated and is now going on. There are 47 cash prizes, from \$2500 down. Complete details, if desired, will be mailed free upon request. The judges are Charles Dana Gibson, artist and president of *Life*; Professor Albert Bushnell Hart, Harvard University; Wm. D. Moffat, editor of *The Mentor*.

Contest Closes Oct. 31, 1923

E. Browning	Moore	Whittier
Poe	Tennyson	Turgenev
Irving	Plato	Longfellow
Ibsen	Wilde	Dante
Shakespeare	Maeterlinck	Elbert Hubbard
Lamb	Yeats	

Is this offer too good to be true?

There are over 3000 pages in this set of books. They are in a very convenient pocket size, so that you can read them, not only at home, but in idle moments while traveling. The paper is equal in quality to that used in the ordinary \$2.00 volume; the type is clear and easy to read; the binding is NOT paper, NOT cardboard, but a beautiful limp de luxe material, more durable than leather, and so handsomely embossed that even experts have mistaken it for hand-tooled leather.

How can thirty such books be sold for only \$2.98? How is it possible? The fact is that the chief difficulty the publishers have

experienced is the belief that such an offer is "too good to be true"—that there must be a "catch" somewhere. Even when people see the books they write and exclaim: "How can you do it?" "It is the most amazing bargain of my life." "Each volume, I would have guessed, was worth at least \$2.00." And so on.

It is no secret, however, how this extraordinary value can be given. These books are printed in editions of at least one million copies at a time. Quantity production—and eliminating middlemen's profits—that is the answer.

Send no money—sent for free examination

Sooner or later, you will want to obtain and read—or re-read, these great masterpieces of literature. Why, then, not order the set at once, when you can get this pair of Lincoln book-ends free, and while the \$5000 Prize Contest is going on?

If you question the unprecedented value, remember that these entire thirty volumes will be sent for examination at our risk. Do not send any money. Simply mail the coupon below. When the package arrives give the postman only \$2.98, plus the few pennies for delivery charges. Then examine the set at your leisure. If you do not agree that this is one of the most wonderful bargains of your life, send the set back any time within thirty days and your money will instantly be refunded. Can a fairer offer be made? References: *Popular Science Monthly* or Manufacturers Trust Co. of New York.

Little Leather Library Corporation

Dept. 6610

354 Fourth Avenue, New York, N. Y.



Little
Leather
Library
Corp'n,
Dept. 6610,
354 Fourth Ave.,
New York City

Please send me the new set of 30 volumes of the Little Leather Library, and a pair of Lincoln Bas-Relief Book-Ends free. I will give the postman \$2.98 plus the few cents' delivery charges upon delivery. It is understood, however, that this is not to be considered as a purchase, I reserve the right to return them within thirty days and you agree to return my money.

Name.....

Address.....

City..... State.....

POPULAR SCIENCE MONTHLY

Most Wonderfully Illustrated Magazine in the World

October, 1923; Vol. 103, No. 4
25 cents a Copy; \$2.50 a Year



Published in New York City at
225 West Thirty-ninth Street

SCIENCE and thought are inseparable twins. Each new discovery, each new invention, has the magic power of thought behind it. But an even more wonderful and more potent force is forethought. Forethought drives science forward to new achievements. It is forethought that permits the scientist to peer into the future, to look over the edge of the present and to see the needs of coming generations.

JULES VERNE was not a scientist, but he possessed the priceless gift of forethought. Fifty-four years ago, in "Twenty Thousand Leagues under the Sea," he fabricated a vivid picture of the modern submarine. Twenty-nine years later he prophesied that the United States would "have mighty navies, not only on the bosom of the Atlantic and Pacific, but in the upper air, and beneath the waters of the surface."

QUITE as amazing as these predictions, both of which have been fulfilled, is the prophecy of Admiral Moffett, chief of aviation, United States Navy, on page 30 of this issue. He pictures an airship 900 feet long, equal to the *Leviathan* in size, carrying a fleet of airplanes as ocean steamers now carry lifeboats, manned by a regiment of men and capable of encircling the globe in a couple of days. When such monsters of the air are practicable, they will draw the ends of the earth closer together. Its peoples will be united in closer understanding, and we may take week-end trips to foreign lands as we now drive into the country in our automobiles.

FORETHOUGHT and courage combined in one man produced a scientist who has been called the "supreme benefactor of the human race"—Louis Pasteur. The dramatic life story of this great Frenchman is told on page 57. It was Pasteur who discovered germs, who found a way of destroying them, who

blazed the path on which all modern surgery and medicine walks. He was jeered at, called an ignorant charlatan. But he persevered and lived to see the scoffers at his feet. Millions are alive today who would be dead but for Pasteur. The whole world is this year observing the centenary of his birth and blessing his memory.

MOST of us, far from exercising forethought, do not use our brains enough even in the ordinary processes of thought. At least, that is the opinion which Dr. James J. Walsh, noted psychologist, expresses in a remarkable article on "Memory" on page 36. Doctor Walsh shows how, by the use of a simple "daily dozen" for the mind, all of us may strengthen our memories and make ourselves more efficient in carrying on the ordinary tasks of life.

FORETHOUGHT of the sort that carries even science into the future is being displayed today by Capt. Donald MacMillan, famous Polar explorer, who has sailed into the illimitable spaces of the Far North. He plans to plant landmarks on the glaciers so scientists of the future may know exactly when the next Age of Ice is coming. In a thrilling article on page 48 Captain MacMillan tells how he will carry out this extraordinary scientific work and how he will attempt for the first time to make radio waves penetrate through the Northern Lights, broadcasting messages to us from the frozen Arctic.

THE forethought of oil men and automobile engineers has furnished us with protection from the odd but fearful fire hazard that tiny sparks of static electricity may bring to motorists. How this is done is told on page 27. In fact, every article published in this number tells of

something made possible by the magic power of forethought.

See Table of Contents on page 127

POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada \$2.50; foreign countries, \$3.

Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.

Copyright, 1923, by the Modern Publishing Co.

The contents of this magazine must not be reprinted without permission
H. J. Fisher, President; R. C. Wilson, Vice-President
O. B. Capen, Secretary and Treasurer

Discovers New Way To Teach Salesmanship in 20 Weeks!



After fifteen years an amazing new method has been formulated whereby it is possible for any ambitious man to get into this fascinating and best paid of all professions in 20 weeks.

By J. E. Greenslade

HERE is the biggest discovery that has been made since men first began to prepare themselves for selling positions through spare time study at home.

After fifteen years intensive study the National Demonstration Method has been perfected—and men can now step into a selling position inside of twenty weeks—with years of practical experience *in their heads*.

This amazing discovery may well enable you to call yourself a MASTER salesman at the very beginning of your actual selling career. For, after all, MASTER salesmanship is nothing more than a knowledge of what to do in *every* situation—and this is what you will have learned from this new method.

For the sales problems which every salesman meets during his experience have all been charted and the most masterful way to handle each of these 64 conditions is shown you. In addition to the National Demonstration Method you will get the same wonderful groundwork of selling and business knowledge which has been responsible for the success of thousands in the past.

How Well It Works

This is the method that enabled Wagner—a fireman—without any previous business training or without any fluency as a talker—to exchange his shovel for a sample case and to exchange his poorly paid hard-working situation for the most fascinating of all professions; with a salary of \$7,000 a year.

After 3 months' study, in his spare time, at home, it enabled H. D. Miller, of Chicago, a stenographer, to step out of a \$100 a month job right into a \$100 a week position.

And I could cite hundreds of other instances, where these remarkable changes from poorly paid positions into this high salaried profession have

been made after from 12 to 20 weeks of this easy, fascinating study. Men in every walk of life have made this change—farmers, laborers, mechanics, bookkeepers, ministers—and even physicians and lawyers have found that Salesmanship paid such large rewards and could be learned so quickly by this new method that they have preferred to ignore the years they spent in reading law or studying medicine and have become master salesmen.

What This Method Means to You

Are you tired of doing routine work which wears a man out long before his time? Are you tired of the daily monotonous grind at a salary that makes it impossible to get any of life's luxuries whatever? Are you tired of the uncertainty of permanence which is always a feature of the average clerical position? Then why not decide to enter the profession where the earnings are high—where the constant demand for good salesmen insure that one may never fear loss of a position and where the work is so fascinating that it is like playing an interesting game and getting paid for it?

Get Free Book on Selling

This amazing new demonstrating method—which gives you years of practical experience in less than 5 months—is all explained in an interesting book called "Modern Salesmanship." It also explains the wonderful opportunities which exist in the selling field and tells all about our free employment service. It should be in the hands of every ambitious man who wishes to insure that his future will be a bright and prosperous one. It will be sent free and without obligation. Mail attached coupon today.

National Salesmen's Training Ass'n.

Dept. 15-R, Chicago, Illinois

National Salesmen's Training Ass'n.

Dept. 15-R, Chicago, Illinois

Send me free book "Modern Salesmanship" which explains the New Demonstration Method and shows how I can become a Master Salesman. This does not obligate me in any way.

Name.....

Address.....

City..... State.....

Age..... Occupation.....

EMPLOYERS

Are invited to write to the Employment Dept. of the N. S. T. A. No charge for this service to you or our members. Employers are also cordially invited to request details about the N. S. T. A. Group Plan of instruction for entire sales forces. Synopsis and chart sent without obligation.

Money Making Opportunities for "Popular Science" Readers



AUTOMOBILES AND ACCESSORIES

PATENTS—Write for free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature. Highest reference. Reasonable terms. Victor J. Evans & Company, 189 Ninth, Washington, D. C.

AUTOMOBILE PARTS—Used parts for most any car at half factory list prices. Allen, Briscoe, Buick, Cadillac, Chalmers, Chevrolet, Dodge, Ford, Grant, Hudson, Hupmobile, Oakland, Overland, Oldsmobile, Reo, Studebaker, and many others. Send list of parts wanted. Maxwell Bros., 4106 Olive St., St. Louis, Missouri.

AUTOMOBILE owners, garagemen, mechanics, send for free copy America's popular motor magazine. Contains helpful, money-saving articles on repairing, overhauling, ignition, carburetors, batteries, etc. Automobile Digest, 523 Butler Bldg., Cincinnati.

FORD ACCESSORIES

SPEEDSTER fans—see "Red-i-Kut" ad, page 114.

WANTED

DETECTIVES—Excellent opportunity. Fascinating work. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, New York.

BE a success. Do you want to know for what vocation you are best fitted? Do you want a better position? Then write us. Particulars free. National Institute for Vocational Success, 214 McCarthy Bldg., Syracuse, New York.

TYPISTS—Earn \$25-\$100 weekly in spare time copying authors' manuscripts. Write R. J. Carnes, P-1, Tallapoosa, Ga., for particulars.

BECOME a ship's officer on passenger and merchant ships. See the world. No enlistment. Regain your health. \$100 to \$150 per month while learning. Write officer in active service. E. W. Gonyan, Detroit River Sta., Str. L. M. Bowers, Michigan.

DUPLICATING DEVICES

"MODERN" Duplicators save Time, Labor and Money. Gets Business. Reproduces Typewritten or Penned Letters, Drawings, Lessons, Music, Menus, Bids, Notices, Specifications, Maps or anything in one or more colors. Prints two per minute. Special sale on. 30 Days' Free Trial. \$2.25 up. Booklet free. J. V. Durkin-Reeves Co., Pittsburgh, Pennsylvania.

STENCIL Duplicators—Two Dollars, Note Size—Letter, Three-fifty. Prints Typewriting—Handwriting. On Approval. Primos Specialty Co., Bx. Primos, Pa.

LABORATORY AND CHEMICAL

EXPERIMENTERS. Complete supplies for the chemical laboratory. Catalogue 5c. National Scientific Supply Co., 241 Pennsylvania Avenue, Washington, D. C.

YOUR chemical problem solved and working process furnished for five dollars. Write me. W. Stedman Richards, Consulting Chemist, Box 2402, Boston, Mass.

LABORATORY apparatus, reagents, scientific books for sale. For particulars address, P. O. Box 98, Ridley Park, Pa.

TRADE SCHOOLS

EARN more money—Learn sign painting, scenic painting, showcard writing, auto painting, paper hanging, decorating, graining, marbling, at Chicago or at your home. Chicago Painting School, 157 West Austin Avenue, Chicago.

PRACTICAL courses in photo-engraving are offered by Wentworth Institute, in co-operation with national and local associations of engravers, at its School of Graphic Arts. The instruction covers work of all the divisions in the industry, and important related subjects. The day course starts on September 24, 1923, the evening course starts on October 1, 1923. Entrance interviews for the day course will be held on September 18 and 19, 1923, at 8.30 A.M., for the evening course on September 21 and 26, 1923, at 7.30 P.M. For particulars write to the Wentworth Institute, Boston 17, Mass.

PAINT Automobiles, Trim Automobiles. Become a certified Electrician. We fit you for a big money job. Make you an expert, able to step right into a position paying \$45 to \$100 per week. We secure you a job while training that more than returns tuition costs and expenses. Come to Detroit, the Automobile Hub; the World's wonder City. Write today. Standard Trades Schools, 416 Woodward Avenue, Detroit, Mich.

DOGS

AIREDALES that I breed people appreciate. Dr. Knox, Danbury, Conn.

DOG REMEDIES

SACOL. A scientific vermifuge. Never failed to get all worms. 75c. Carbon Tetra chloride capsules, 50c. Send postal for literature. Sacol, 7816 90th Rd., Woodhaven, L. I.

Another \$25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:—

What advertisement of "Money Making Opportunities" in this issue interests you most—and why?

Here are the prizes we will pay for the ten best letters answering the above question:—

First Prize.....\$10.00
Second Prize.....5.00
Third Prize.....3.00
And 7 Prizes
of \$1.00 each.....7.00

First read every one of the "Money Making Opportunity" advertisements on pages 4 to 20. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, *not more than seventy words*, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before October 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the December Issue. Address your prize letter to—

Contest Editor

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York City

Last Month's Prize Winners

The first prize of \$10.00 goes to Miss M. W. Mattern, 4405 N. Fourth St., Philadelphia, Pa., for her letter on the advertisement of E. Lancaster, Los Angeles, Calif.

The second prize goes to Gruver Davis, 441 East Wolfe Street, Harrisonburg, Va., for his letter on the advertisement of American Photography Company.

The third prize goes to Mrs. M. G. Bass, McGehee, Arkansas, for her letter on the advertisement of The Universal Scenario Corp.

The winners of the other seven prizes are:—

J. White, Kingston, Ontario, Canada; Francis B. Gregory, Syracuse, N. Y.; E. N. Moxey, Philadelphia, Pa.; A. Jean Lowe, Lakewood, Ohio; I. O. Tucker, Charlestown, Mass.; C. H. Thomas, Kennett Square, Pa.; Isabelle Shaffer, Reno, Nevada.

REAL ESTATE AND FARM LANDS

PECAN-Orange groves. Department S. Suburban Orchards Co., Oceansprings, Mississippi.

ARKANSAS Land \$10.00 per acre in tracts five acres or more. Timbered land near oil development. A sound investment with good speculative chances. Write for full details. H. J. McMullen, F & M Building, Fort Worth, Texas

LETTER SPECIALISTS

MY master sales letters, prepared to your order, will show big, profitable sales returns. Ad-Expert Mac Fee, 2731 Warren Avenue, Chicago.

OPTICAL GOODS

ARTIFICIAL eyes. \$3. Booklet free. Denver Optic, 508 Barclay, Denver, Colorado.

CONSULTING ENGINEERS

STEEL Problems Solved. Practical. E. W. Rettew, Consulting Metallurgist, Wyomissing, Pennsylvania.

Rate 25 Cents a Word. Advertisements intended for the December issue should be received by Oct. 5

AVIATION

THE American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 174C, 3601 Michigan Ave., Chicago, Illinois.

PROPELLERS for aeroplane propulsion, 5-foot diameters, \$12; 6-foot for Ford, \$15; others in proportion. Motorcycle sleigh blueprints, 75c; Ford size, \$1.00. Pictures free. Crawford Motor and Aeroplane, Long Beach, Calif.

MOTORCYCLES, BICYCLES, SUPPLIES

DON'T buy a bicycle motor attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galveston, Kansas.

PARTS for all motorcycles cheap. Schuck Cycle Co., 1922 Westlake, Seattle, Washington.

NEW and Used Parts for all makes. Send for our prices. Kingshighway Cycle Co., 1166 North Kingshighway, St. Louis, Missouri.

DEALERS and riders: Attention: Write for our special Motor cycle saving bulletins. Dealer's bulletin No. 8 and rider's bulletin No. 42. Motorcycle Parts Mfg. Co., 2030 Wabash Ave., Chicago, Ill.

MODELS AND MODEL SUPPLIES

WE make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

MODEL making and experimental work; modern shop, expert workmen. Manufacturing. Lamson El. & Mfg. Co., 625 W. Jackson, Chicago.

BEFORE ordering your model write for free copy of Modelcraft. R. G. Clyne Engineering Co., St. Louis, Mo.

MODEL Making Supplies—2"-4" diameter, special thin brass tubing for Model Boilers, 10c.-20c. per inch. Machine ends, per pair, 2", 75c.; 4", \$1.50. Miniature machine screws, 3/32" up. Finished Boiler Fittings Catalogue, 20c. Bathe Mfg. Co., Dept. C., 5214 Woodland Ave., Philadelphia, Pa.

MOTORS, ENGINES, MACHINERY

MOTORS—G. E., 1/4 H. P., \$15.00; 1/2 H. P., \$32.50; 1 H. P., \$62.50. Generators, 8 volt, 10 amp., \$15.00; 32 volt, 500 watt, \$30.00. Other sizes, low prices. Motor Specialties Co., Crafton, Pa.

SPEED LATHE—Build your own at trifling cost. Big money in wood turning. Detail blueprint No. 851, \$1.00. Jno. H. Neef, Civil Engineer, Salem, Oregon.

RADIO AND SUPPLIES

TESTED radio recipes. One Skinderviken transmitter button mixed with radio set gives amplification and loud-speaking. Free literature. K Electric Co., 15 Park Row, New York.

1500 MILE vacuum tube receiver \$24.50. Radio, 4416 Market, Philadelphia.

RADIO World. Great national illustrated weekly; 15c copy. All newsdealers. Trial sub. \$1.00 seven issues. 1493 Broadway, N. Y.

RADIO generators 500 V 100 Watt \$28.50 each. Battery Chargers \$12.40—High speed motors. Motor-Generator sets, all sizes. Motor Specialties Co., Crafton, Pa.

FORMULAS

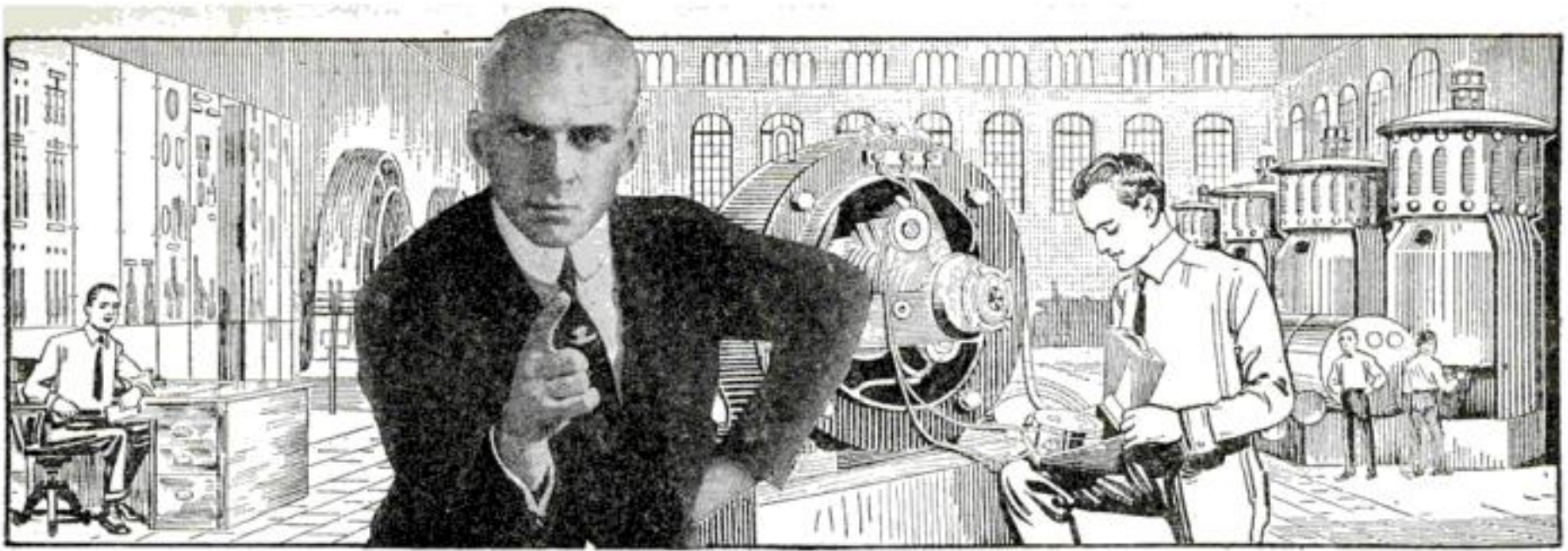
FORMULA catalog free. C. A. Lutz, Apartment 241, York, Pennsylvania.

NO mistake Auto cleaner and polish. One operation, cleans anything. Positively Guaranteed. Formula, One Dollar, Flandt & Co., Wolcottville, Ind.

AMERICAN MADE TOYS

MANUFACTURERS on large scale, also homeworkers wanted to manufacture metal toys and novelties. Millions needed of barking dogs, wag tail pups, wild animals, automobiles, Indians, cowboys, baseball players, cannons, toy soldiers, crowing roosters, statues of Liberty, miniature castings of capital, bathing girl souvenirs and others. Unlimited possibilities. Guaranteed casting forms furnished manufacturers at cost price from \$5.00 up, with complete outfit. No experience or tools necessary. Thousands made complete per hour. We buy goods all year and pay high price for finished goods. Cash on delivery. Contract orders placed with manufacturers. Catalog and information free. Correspondence invited only if you mean business. Metal Cast Products Co., 1693 Boston Road, New York.

**More Money Making Opportunities
on pages 4 to 20**



Electricity Needs You I WILL TRAIN YOU AT HOME

Stop right here. This is YOUR opportunity! Electricity is calling you, and the Electrical Business is in for a tremendous increase. But it needs more trained men—at big pay. By my **Home Study Course in Practical Electricity** I can train you for these positions.

FREE!

BIG ELECTRICAL OUTFIT

A fine outfit of Electrical Tools, Instruments, Materials, etc., absolutely FREE to every student. I will also send you FREE and fully Prepaid—Proof Lessons to show you how easily you can learn Electricity and enter this splendid profession by my new revised and original system of Training by Mail.

RADIO COURSE FREE

Special newly-written wireless course worth \$45.00 given away FREE.

Free Use of Laboratory

I have a large splendidly equipped Electrical Laboratory where you can come at any time for special instruction without charge. Several competent assistants—practical engineers—are in charge.

Earn Money While Learning

I give you something you can use now. Early in my **Home Study Course** I show you how to begin making money in Electricity, and help you get started. No need to wait until the whole course is completed. Hundreds of students have made several times the cost of their course in spare time while learning.

Earn \$70 to \$200 a Week

You've always had a liking for Electricity and a hankering to do electrical jobs. Now is the time to develop that talent; there's big money in it. Even if you don't know anything at all about Electricity you can quickly grasp it by my up-to-date, practical method of teaching. You will find it intensely interesting and highly profitable. I've trained and started hundreds of men in the Electrical business, men who have made big successes. YOU CAN ALSO

BE A BIG PAID Electrical Expert

What are you doing to prepare yourself for a real success? At the rate you are going where will you be in ten years from now? Have you the specialized training that will put you on the road to success? Have you ambition enough to **prepare** for success, and get it?

You have the ambition and I will give you the training, so get **busy**. I am offering you **success** and all that goes with it. Will you take it? I'll make you an **ELECTRICAL EXPERT**. I will train you as you should be trained. I will give you the benefit of my advice and 20 years of engineering experience and help you in every way to the biggest, possible success.

Valuable Book Free

My Book, "How to Become an Electrical Expert," has started many a man on his way to fortune. I will send a copy free and prepaid to every person answering this advertisement!

Act Now! Good intentions never get you anywhere. It is action, alone, that counts. NOW IS THE TIME TO ACT.

L. L. COOKE, Chief Engineer

CHICAGO ENGINEERING WORKS

2150 LAWRENCE AVENUE

Dept. 37,

Chicago, U. S. A.

CHIEF ENGINEER
COOKE

Chicago Engineering
Works

Dept. 37, 2150 Lawrence Ave.
CHICAGO, ILL.

DEAR SIR: You may send me entirely free and fully prepaid, a copy of your book, "How to Become an Electrical Expert," and particulars about your Home Study Course in Electricity.

Name

Address

City State

The Cooke trained man is the "Big-Pay" man

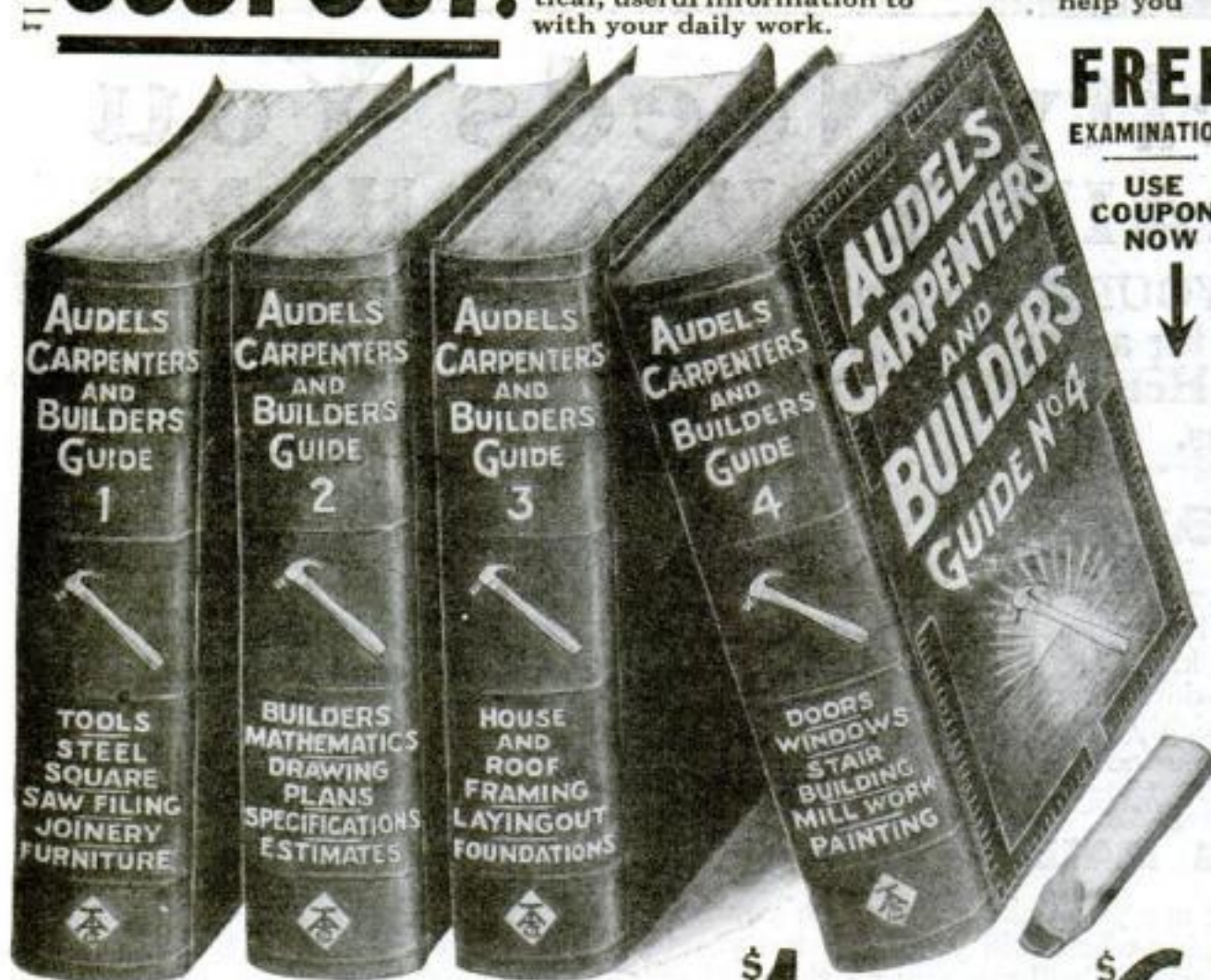
CARPENTERS AND BUILDERS!

Just available—Audel's Carpenters and Builders Guides—the short cut, professional information you want.

A Guide that keeps you in close touch with your work and shows you how you may increase your earning power.

No need to guess or take chances. Every day you have before you in this set, exact, practical, useful information to help you with your daily work.

JUST OUT!



**FREE
EXAMINATION**

**USE
COUPON
NOW**

POCKET SIZE-FLEXIBLE COVERS

There are thousands of examples of modern construction and building work—new methods, new ideas, proved efficiency plans, short cuts, time saving suggestions, new ways that cover the entire theory and practice of modern carpentry. Every point is

easy to read and understand and clearly illustrated with sketches and forms. Decide for yourself whether they are worth the money to you. Pay only \$1 a month if you like them. Return the Guides if you don't. **USE COUPON NOW!**

HOW To Handle the Job That Puzzles YOU

How to use the different kinds of wood—complete detailed information on nails and screws—how to use the steel square—how to file and set saws—how to make wood joints—how to build furniture—how to make a mitre shooting board—how to plumb, and level work—how to lay out work—how to understand

carpenter's arithmetic—how to solve mensuration problems—how to estimate the strength of timbers—how to proportion beams—how to read plans—how to draw up specifications—how to estimate the cost of buildings—how to build houses, barns, garages, bungalows, etc.—how to build foundations—how to proportion foundation footings—how to frame houses—how to set girders and sills—how to frame joists—how to frame a studding—

how to set window frames—how to cut rafters—how to use the settings 12, 13, and 17 on the steel square—how to put on wood, fibre and metal shingles—how to hang doors—how to frame windows—how to put on sheathing—how to put on exterior trim—how to do cornice work—how to build stairs—how to lay floors—how to paint.

FREE EXAMINATION

Not a cent to pay until you see the books. No obligation to pay unless you are satisfied. Send coupon now—today and get this fine, helpful new set for Carpenters and Builders. After you have looked them over 3 days send only \$1, then \$1 a month until \$6 is paid—if you want to keep them. Return them if you do not.



**SEND NO
MONEY
SEND THIS
COUPON ONLY**

THEO. AUDEL & CO., 72 Fifth Avenue, New York City.

Please submit me for approval and free examination:—
AUDEL'S CARPENTERS AND BUILDERS GUIDES

Ship at once, prepaid, the 4 numbers. If satisfactory I agree to send you \$1 within five days and to further mail you \$1 monthly until \$6 is paid.

Name.....

Address.....

Employed by.....Reference.....

Pop. Sci. Oct. '23

Money Making Opportunities

ADVERTISING

ADVERTISE in 24 metropolitan dailies, 24 words, \$15.00. Helpful Guide listing 1000 publications, 4c stamps. Wade Company, Baltimore Bldg., Chicago.

ADVERTISING rates for magazines and weeklies free. Charles A. Lutz, Apartment 241, York, Pennsylvania.

25 WORDS—355 rural weeklies. \$14.20. Meyer Agency, 4112P Hartford, St. Louis.

PRINTED lists of weeklies and monthlies Free. Stanley Day Adv. Agency, Plainfield, N. J.

INCH Display, 100 magazines, thrice \$8. Beck, 5406 Alaska, St. Louis.

CONNECTICUT Advertisers! "Home Occupations," read by thousands, brings results. Write for sample copy and ad rates. Home Occupations, Box A, 328 Richards Ave., Dover, N. J.

FOR THE HOME

GRANDFATHER clock works, \$5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Pennsylvania.

ADDING MACHINES

FREE trial, marvelous free adding machine. Adds, subtracts, multiplies, divides, automatically. Work equals \$350.00 machine. Price only \$15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write today for catalog and free trial offer. Lightning Calculator Co., Dept. O, Grand Rapids, Mich.

MISCELLANEOUS

MAKE interesting new friends through jolly letters. Betty Lee, Inc., 4254 Broadway, New York City. Stamp appreciated.

BRITISH girls desire American correspondents. Proposition 10c. Clark, 16 Cambridge St., London, S. W., England.

CREATE international friendships. Free information. Write: "Universalist," 1034-A West Eighteenth Street, Chicago, Illinois.

EXCHANGE postcards with 28 countries; use our Esperanto "form letters." Forms and 50 addresses 50c. Thousands eager to exchange. Ferguson Press, Jeffersonville, Indiana.

EXCHANGE letters with new acquaintances made through membership in correspondence club. Address P. O. Box 2362, Denver, Colorado.

LONESOME—Join our club—make acquaintances everywhere. Big illustrated book with descriptions and photos, sent in plain wrapper for ten cents. Bonafide Co., Dept. 43, Kansas City, Mo.

JOIN the old reliable card club. Membership 10c. Riverside Club, Dept. 3, Frederick, Md.

HOMEOPATHIC and Biochemic preparations sent postpaid to all parts of the world. Manual and booklets free. Halsey Bros. Co., 111 N. Wabash Ave., Chicago, Illinois. Established 1855.

WISH New Friends? Many ladies and gentlemen desire correspondents. Write Good Fellowship Club, Woodhaven, New York. (Stamp.)

FOR MEN AND WOMEN

"SEXUAL philosophy," 12c. Clear, specific, authoritative, complete, best, satisfies. Fred B. Kaessmann, Lawrence, Massachusetts.

GENUINE Indian baskets, blankets and wampum—wholesale. Catalogue. Gilham, Kelseyville, California.

MAGIC words! Secret, sure method of obtaining anything you want. Postpaid for dime. Lida Smedley, 145 Miller, Brooklyn, N. Y.

TOBACCO or Snuff Habit cured or no pay. \$1.00 if cured. Remedy sent on trial. Superba Co., X-5, Baltimore, Md.

CIVILIZATION saved by "Right Rule," easy as water's flow. One Amendment Turns Chaos to Order, here—now—forever. Greatest plan, of man for man, since man began. Billions need it. \$1. N. U. World, Dept. C, Benton Harbor, Mich.

HOROSCOPES

YOUR Horoscope, business, changes, social, matrimonial prospects. Send birthdate and 10 cents (stamps) for remarkable test reading. Zanya, M-202 West 105th Street, New York.

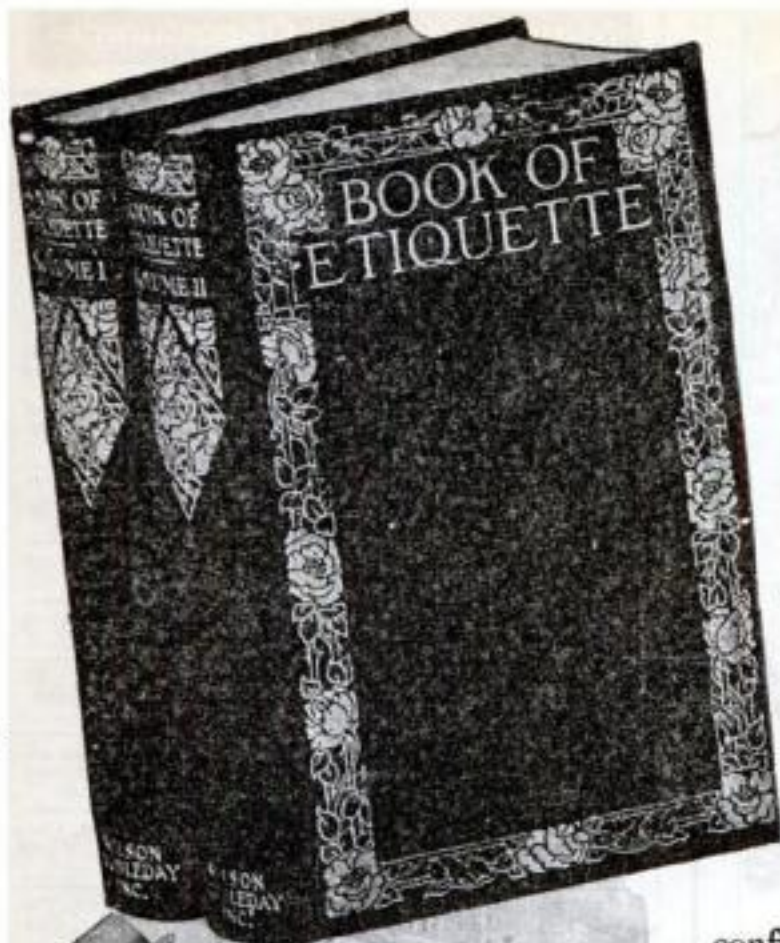
PATENT BUYERS

PATENTS, is yours for sale, write for offer. Western Distributors, De Soto, Iowa.

FOR SALE

FOR sale, complete set of watchmaker's tools at a bargain. R. Jaegermann, 5815 Easton Ave., St. Louis, Missouri.

**More Money Making Opportunities
on pages 4 to 20**



Special Bargain!

The Famous Book of Etiquette

Nearly Half a Million Sold at \$3⁵⁰

NOW ONLY \$1⁹⁸
For a Very Limited Time

YOU have always wanted this famous two-volume set that solves every social difficulty, that tells you exactly what to do, say, write and wear on every occasion. You have always wanted to own the two remarkable books that give poise, ease, dignity—self-confidence.

Here is your opportunity to secure the complete, original, authentic **BOOK OF ETIQUETTE** at almost *half* the usual publisher's price! Almost 500,000 people have purchased the Book of Etiquette at the regular price of \$3.50. If you act **NOW**, you can receive the same two authoritative and fascinating volumes for only \$1.98.

This amazing offer is for a short time only. The demand for the Book of Etiquette at this great reduction will probably be so large that the company must reserve the right to withdraw this offer at any time. You are urged to send for your set at once.

Solves Every Social Problem

The Book of Etiquette is admittedly one of the most complete and authoritative works of its kind ever published. It covers every phase of wedding etiquette, street etiquette, dinner etiquette, dance etiquette—it contains paragraphs for the self-conscious and timid; for the bachelor; for the business woman; for the country hostess. Nothing is forgotten, nothing omitted. The Book of Etiquette will tell you everything you want to know. It will protect you from sudden embarrassments, give you a wonderful new ease and poise of manner.

Wherever possible, in the Book of Etiquette, the origin of customs has been traced to its source. For instance, you find out why rice is thrown after the bride, why a veil is worn, why the engaged girl is given

a tea-cup. You will enjoy the Book of Etiquette. And you will find it more useful than you ever dreamed a work of this kind could be.

SEND NO MONEY

Here's your chance—take it! Let us send you the famous two-volume Book of Etiquette at the *special offer price*.

No money is necessary. Just clip and mail the coupon below to us at once. We will send you the complete, two-volume set of the Book of Etiquette, and when it arrives you have the privilege of giving the postman only \$1.98 (plus a few cents postage) for the regular \$3.50 set!

Surely you are not going to let this offer slip by. Clip and mail this coupon **NOW** while you are thinking about it. Nelson Doubleday, Inc., Dept. 2510, Garden City, New York.

USE THIS SPECIAL COUPON

Nelson Doubleday, Inc., Dept. 2510, Garden City, N. Y.

I accept your special offer. You may send me the complete, two-volume set of the Book of Etiquette. When it arrives I will give the postman only \$1.98 (plus a few cents postage) instead of \$3.50, the regular price. I retain the privilege of returning the books any time within 5 days of their receipt, and my money will be refunded at once if I demand it.

Name.....

Address.....



"Goodbye, I'm Very Glad to Have Met You"

But he ISN'T glad. He is smiling to hide his confusion. He would have given anything to avoid the embarrassment, the discomfort he has just experienced. Every day people who are not accustomed to good society make the mistake that he is making. Do you know what it is? Can you point it out?



Are You Ever "Alone" in a Crowd?

Good manners make good mixers. The man or woman who is able to do the correct and cultured thing without stopping to think about it, is the man or woman who is always welcome, always popular, always happy and at ease.

Do you ever feel alone at a social gathering? Do you ever feel tongue-tied among strangers?



What's Wrong in This Picture?

It is so easy to make embarrassing mistakes in public—so easy to commit blunders that make people misjudge you. Can you find the mistake or mistakes that are made in this picture?



Learn Electricity in 3 Months in the Great Shops of Coyne

We pay your railroad fare to Chicago—the Electrical Center of the World—from any place in the United States. Grasp this opportunity to see the country at our expense. Don't stick in one spot—travel—get experience. Come to Coyne—the largest electrical school in the country specializing in electrical instruction only. Learn electricity in three months. Fit yourself for a big paying job. Get a complete training so you can make big money as Power Plant Operator, Superintendent, Telephone man, Construction worker, auto, truck or tractor electrician, battery man, radio expert, or you can go into business for yourself as electrical contractor, dealer, auto ignition or battery expert and make from \$3,000 to \$20,000 a year. Hundreds of our graduates today are making big money and you can do the same if you grasp this opportunity—act now.

Fit Yourself for a Big Paying Job

No books or useless theory. You are trained on \$200,000 worth of electrical equipment. Everything from door bells to power plants. You work on motors, generators, house-wiring, autos, batteries, radio, switch-boards, power plants—everything to make you an expert ready to step right into a position paying from \$45 to \$100 a week.

RADIO COURSE FREE

We give you free a course in Radio—the marvel of the age. Constructing, installing and operating. You can build your own radio receiving set.

The complete electrical course gives you practical training in Circuits, House Wiring, D. C., A. C., Armature and Stator Winding, Drafting, Auto, Truck and Tractor Electricity, Battery Building and Repairing and Radio. In addition you receive Free, a Life Membership which enables you to stay as long as you want or come back for further training at any time without charge.

Earn while you learn! We help students to secure jobs to earn a good part of their expenses while studying

Send Coupon

Don't delay a minute; send that coupon right now for

B. W. Cooke, Pres.

COYNE ELECTRICAL SCHOOL

1300-1310 W. Harrison St., Dept. 13-67 Chicago

Dear Sir: Please send me free your big catalog and full particulars of your special offer of Free Railroad Fare and two extra courses.

Name.....

Address.....

our big free catalog and full particulars of Free Railroad Fare offer. Remember this special offer is limited so act now.



Student Winding a Stator

COYNE
Electrical School

Endorsed by Electrical Industry

1300-1310 W. Harrison St., Dept. 13-67 Chicago

Money Making Opportunities

PRINTING, ENGRAVING, MULTIGRAPHING

BETTER printing for less money! Send for our large package of samples of hundreds of items every user of printing is interested in. These samples worth dollars will be sent for 10 cents to pay postage. Ernest Fantus Company, 525 South Dearborn Street, Chicago.

EMBOSS business, personal stationery. Samples, stamp. Daniels P. Company, Pittston, Pennsylvania.

225 BOND letterheads, envelopes, billheads, cards, \$1.25 each. Combination, \$4. Economic Printery, Leonia, New Jersey.

LETTERHEADS, envelopes, 500, \$2.65. Samples free. Quality Printery, Marietta, Ohio.

BOND envelopes or letterheads, \$3.60 M. prepaid. C. H. Davis & Son, News Agency, 614 Jefferson, Greenfield, Ohio.

PRINTING! Envelopes, letterheads, billheads, circulars. Samples. Franklin Press, B-34, Milford, New Hampshire.

1000 PRINTED Statements, Letterheads or Envelopes, \$3.75 delivered. Box 275, Saranac Lake, N. Y.

1,000 BOND letterheads, envelopes, \$3.25; 250, \$1.25. Samples free. Troib Press, 98-A Providence, Worcester, Mass.

200 PERSONAL correspondence letterheads, 100 envelopes, \$1.00. "Superior," 1825 Roosevelt, Indianapolis, Ind.

ARTISTIC visiting cards. Embossed in gold. 100, 40c.; 300, \$1.00. Card Case free. Artistic Printery, 45 Sixth Ave., Newark, New Jersey.

WHEN in need of printing, "The Better Kind," write The Olde Tye Press, Box A, 328 Richards Avenue, Dover, New Jersey.

MANUFACTURING

UNUSUAL opportunity—New factory well equipped for dies, stamping, die-casting, screw-machine and wire products. Plating, enameling, burnishing. Quotation to responsible parties. Metal-Craft Mfg. Co., Box 259, Chicago.

WE design and build special machinery. Send for free copy of Modelcraft. R. G. Clyne Engineering Co., St. Louis, Mo.

TO order: Metal articles, simple, or complicated machinery. Models, tools, patterns. Experimenting. Parma Engineering Co., Brooklyn Station, Cleveland, O.

EDUCATIONAL AND INSTRUCTION

DEGREES earned by correspondence study in Engineering, science, law, theology, medicine, etc., 700 courses. Catalog free. P. S. Oriental University, 1702 Oregon Ave., N. W., Washington, D. C.

DOUBLE entry bookkeeping mastered in 60 hours; guaranteed; diploma. International Bookkeeping Institute, Springfield, Missouri, Desk 10.

LINCOLN-JEFFERSON University. Home Study in Academy College, Theological, Law, Music, Pharmacy, Business and Graduate schools, leading to degrees. Box G, 64 W. Randolph Street, Chicago.

HYPNOTISM easily learned. Lessons guaranteed. Postpaid \$1.10. Smith Publishing Co., Springfield, Mass.

SHORTHAND in 100 hours. Most rapid readable system. Introductory booklet free. Memoscript Institute, Roanoke, Virginia.

USED correspondence courses and educational books bought and sold. Attractive prices. Educational Service, Park Ave., Piqua, Ohio.

USED correspondence courses bought and sold. Bargain catalogue 1000 courses free. Students' Exchange, Dept. 3, 47 West 42d St., New York.

ARTISTS' MATERIALS

PAINTERS, decorators, printers, artists—3000 color mixing guide, \$1.00. Fine Arts Publisher, 1125 W. 27th, Indianapolis, Indiana.

GAMES AND ENTERTAINMENTS

MAGIC, stage money, books. Catalogs 10c. Gilmaglen, Morgan Park, Chicago.

TRICKS—Parlor or stage. Superior quality. 160-page illustrated catalog, 10c. Oaks Magical Co., Dept. 200, Oshkosh, Wisconsin.

EXCHANGE interesting letters with new friends. Dolly J. Gray, Box 180, Denver, Colorado.

YOU'LL have lots of fun exchanging cheery letters in my club. Eva Moore, Box 908, Jacksonville, Florida. (Stamp.)

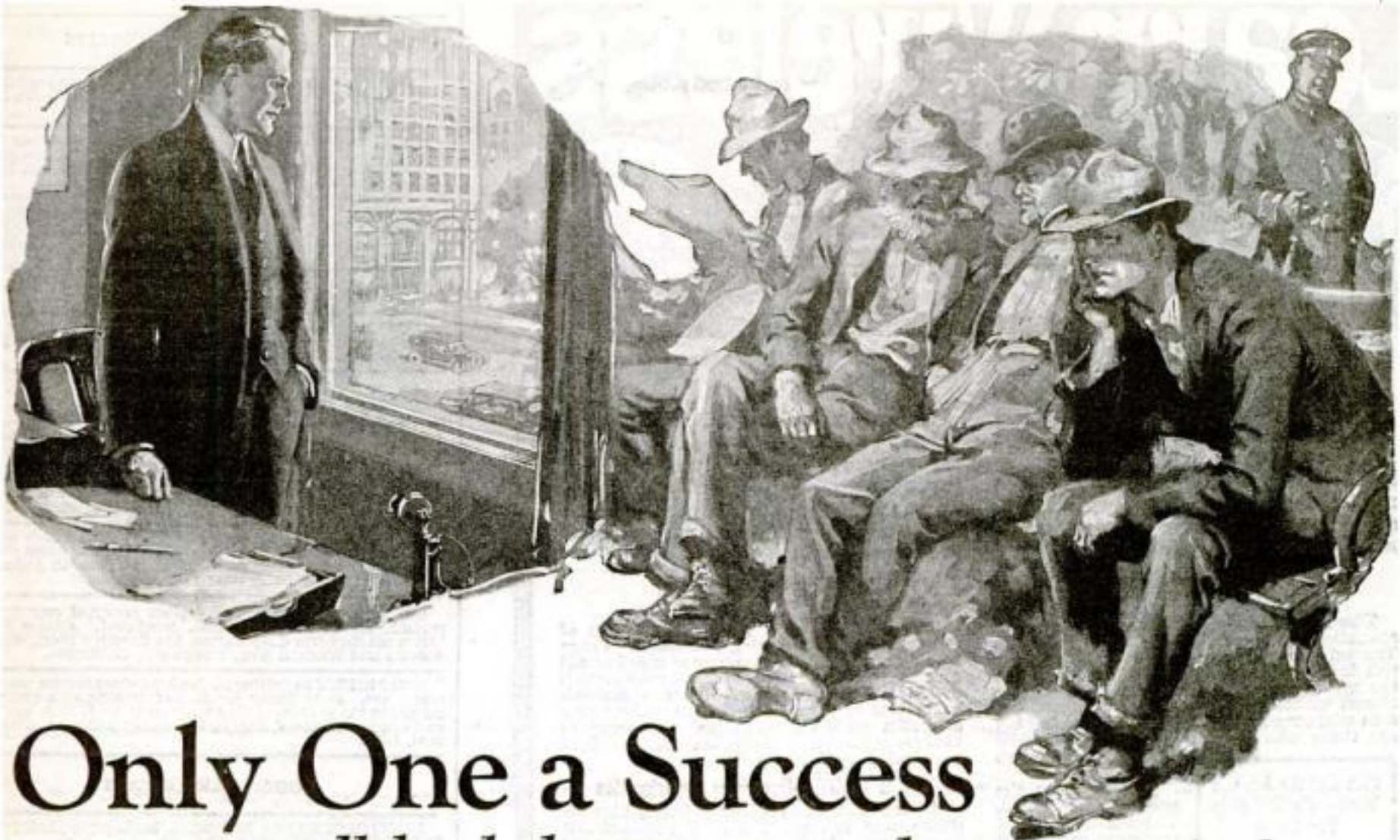
CHINESE NOVELTIES

BUY oriental goods at wholesale prices, save 30%. Catalog free. Shanghai Trading Co., San Francisco.

OFFICE DEVICES

ADDRESSING machines, multigraphs, duplicators, folders, check writers, sealers, dictating machines, at about half new cost. Pruitt, 170-2 North Wells, Chicago.

More Money Making Opportunities on pages 4 to 20



Only One a Success

—yet all had the same good opportunity!

If someone should tell you that five years from now you would be sunning yourself on a park bench—out of work, out of luck, and convinced that you were a failure—you would probably tell him in no uncertain terms that he was a liar.

And quite probably you would be right.

Every few years, however, the benches are peopled with hundreds and thousands of men in exactly that predicament—and the thing that confounds one is the fact that hardly a man of the lot, five years before, would have believed it possible.

While Others Were Being Displaced This Man Won Promotion

People judge harshly when they say that the men who thus find themselves out of work are not deserving of employment.

There are no finer fellows living than the thousands of men who returned from France to find that there were not places enough to go round. Fortunately, most of these men are now at work. But there was a time—and not so long ago—when they were forced almost to beg for a place.

These men deserved employment, if ever men deserved it—but—business at that time was in such condition that only men who had PROTECTED their jobs by TRAINING—by the development of some special ability to do some special thing—were able to hold their own against depression.

During this period, when men were struggling to get on their feet once more, even LaSalle-trained men did not always have it easy. Demand even for men who have EQUIPPED themselves to perform some special work does not always equal supply.

But—make no mistake—their lot was easier BY FAR than that of the men who could offer merely WILLINGNESS TO WORK.

And in countless instances it was the LASALLE-TRAINED MAN who was retained when others were let go—and in countless instances he won promotion.

There comes to mind, for example, the experience of Sidney Lichtenstein, of Philadelphia, who in August, 1920—just as the

business depression was causing many a concern to shut up shop—enrolled for LaSalle training in Modern Business Correspondence and Practice, and who, in January, 1921, after completing only eight assignments, reported a 40 per cent increase in salary—"when all other employees of the company were being discharged or receiving salary cuts."

"LaSalle," wrote Lichtenstein, "is not only a means for increased efficiency, it is insurance against hard times. As soon as I have completed my present course, you'll find me enrolled for another."

—Not particularly dramatic—Lichtenstein's experience—but it was not selected for dramatic purposes. It is merely TYPICAL.

Secure In Their Jobs and Rapidly Advancing

Times are booming now—there is plenty of work for the routine office man—and if he is content with a handful of change each week, his employer will likely enough be disposed to keep him. "All's well," says the man who has no ambition. "Perhaps a year from now, three years from now, I'll be sunning myself on a bench and twirling my thumbs—but for today and perhaps tomorrow—All's well!"

If you belong to the great army of the easy-going—and are content to STAY in those ranks—LaSalle can do very little for you.

If, on the other hand, you are in earnest to GET AHEAD—you will find encouragement in such statements as the following—from LaSalle-trained men who are using their evening hours for advancement:

"The knowledge I secured from your Higher Accountancy course and the progressive spirit of your instructors gave me the courage to make a start, and I have since held many responsible positions, conducted investigations, and opened up many sets of books with ease. My present earning power is at least 300 per cent greater than the salary I drew at the time of my enrollment."

L. R. ELSESSER, Michigan.

"Your training in Traffic Management, which I took last fall, started me up the ladder of success and enabled me to increase my earnings \$60 a month—directly as a result of taking your course."

"Words cannot express how much I appreciate your advising me of the position, which I later secured, as rate clerk for the..... Railroad. I like my work and have decided to become an expert in it, with your help; and am expecting to go on up into the bigger and more responsible positions with the railroads."

A. H. WALTON, Georgia.

"Passed the Arizona bar examination last week at the head of a class of seventeen, including graduates from some of the best-known resident

law schools in the country. I certainly do appreciate what you have done for me, and realize better than ever the excellence of the LaSalle course and the methods of teaching you employ."

C. A. CARSON, JR., Arizona.

"Your course in Modern Salesmanship has given me many ideas and plans of action, methods of finding the market for merchandise, making the most of an article's selling points, and approaching the prospective buyer, and has helped me wonderfully in that hardest part of a salesman's job, namely, closing the deal. With my course less than half completed I can emphatically say that the knowledge derived therefrom, if measured in dollars and cents, would exceed \$1,000."

CLARENCE A. EVANS, Ohio.

"When I enrolled for your Business Management course I was just plugging along with an ordinary bookkeeper's job, but today I am proud to say that I am out of that rut and have full charge of all the work in the office. Very often I am left to manage the entire business, and I have also been awarded an increase in salary which up to this time is over 400 per cent."

J. GLENN HOBBS, Georgia.

What Will YOU Write Home to the Folks?

What does the future hold for YOU?

Will you write back home, "I've just had a 'raise'—I'm head of my department now"—or—"I had hard luck last week; I've got to look for another job?"

There's a little coupon just below this text which has guided many a man into secure and profitable positions.

The man who is sincere in his desire to increase his earning power will do well to mark and sign and mail the coupon NOW.

LaSalle Extension University

The Largest Business Training Institution in the World
Dept. 1083-R Chicago, Illinois

Upon request, the book "Ten Years' Promotion in One," and material completely descriptive of the course and service that interests you, will gladly be sent without cost or obligation. Indicate your choice by checking, and write below your name and address.

- | | |
|---|--|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Modern Business Correspondence and Practice |
| <input type="checkbox"/> Modern Salesmanship | <input type="checkbox"/> Modern Foremanship and Production Methods |
| <input type="checkbox"/> Higher Accountancy | <input type="checkbox"/> Personnel and Employment Management |
| <input type="checkbox"/> Law: Degree of LL. B. | <input type="checkbox"/> Expert Bookkeeping |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Railway Station Management | <input type="checkbox"/> Commercial Spanish |
| <input type="checkbox"/> Commercial Law | <input type="checkbox"/> Effective Speaking |
| <input type="checkbox"/> Industrial Management Efficiency | <input type="checkbox"/> C. P. A. Coaching |
| <input type="checkbox"/> Banking and Finance | |

Name

Present Position

Address

Learn Wireless At Home In Spare Time

Earn \$2,400 to \$10,000 a Year

The man who would be a success in business today must be a specialist. The market is already crowded with clerks, stenographers, accountants and detail men of every description. That is why

RADIO NEEDS TRAINED MEN

There is probably no other field today where specialists are needed more than in Radio. Trained men are needed in every branch of this fascinating, profitable profession. And the opportunities for trained men are great—almost without limit. Even in this field, the men who stand the best chance of landing big are those who enter this field NOW while Radio is growing so rapidly.

Pick Out the Job You Want—We Will Help You Get It

This is a brief list of the positions in the Radio field today, and the salaries paid—
Radio Mechanic, \$1,500 to \$4,000 a year.
Radio Inspector, \$1,800 to \$4,500 a year.
Radio Salesman, \$2,000 to \$10,000 a year.
Radio Engineer, \$3,500 a year and up.
Radio Executives up to \$15,000 a year.
Radio Instructor \$200 to \$500 a month.
Radio Draftsmen, \$7 to \$15 a day.
First Class Ship Operator, \$105 a month, all expenses paid.
Second Class Ship Operator, \$95 a month, all expenses paid.
Third Class Operator, \$85 a month all expenses paid.
Commercial Land Station Operator, \$150 a month and up.
Broadcasting Station Operator, \$125 to \$250 a month.

You Can Qualify at Home Easily and Quickly

If YOU are sick of plodding along in the daily grind of monotonous office routine—held down by thousands of men

the chances are so strongly against their getting big pay. But look at the men who are earning real big money today. In practically every case we find them to be specialists!

doing the same work you are—get out of the rut into a big paying profession. Learn Radio at home. A short course of training will quickly enable you to be independent, to travel and see the world if you care to, or to establish a business of your own. It will make you a specialist with the unlimited opportunities that are open to a specialist in this tremendous uncrowded field of Radio.

FREE BOOK—Describes Opportunities

To any man who is eager to better his condition, and is interested in the remarkable opportunities in Radio, we will gladly send a copy of our newly published book on radio—*absolutely free*. You assume no obligation whatever in sending for this interesting, helpful book. It is yours for the asking.

Send for your copy of "How to Learn Radio at Home" and learn all about the wonderful opportunities that are opening in Radio, how we train men for them and help them to the best positions. Read actual experiences of many of our students since we have trained them. "Tune in" on a real job. Mail the coupon for this interesting Free Book today. It will pay you! **National Radio Institute, Dept. 12-J Washington D. C.**



National Radio Institute
Dept. 12-J Washington, D. C.

Without any obligation on my part, please send me a FREE copy of your book, "How to Learn Radio at Home." Also tell me how your Free Employment Service will help me to a position and send details of your special short-time offer.

Name.....
Street.....
City..... State.....

LEARN AUTOS and TRACTORS

Wonderful opportunities constantly offered trained men—We train you thoroughly to start your own business, or to make good money as motor expert, driver, shop foreman, etc., and furnish you with a \$12.00 tool kit free of charge. This is the pioneer auto school.
Over 7000 graduates making good.
Catalog free.
Cleveland Automobile School, 1821 East 24th Street, Cleveland, Ohio

EARN MONEY AT HOME

YOU can make \$15 to \$60 weekly in your spare time writing show cards. No canvassing or soliciting. We instruct you by our new simple Directograph system, pay you cash each week and guarantee you steady work. Write for full particulars and free booklet.
WEST-ANGUS SHOW CARD SERVICE LIMITED
Authorized Capital \$1,250,000.00
63 Colborne Building Toronto, Can.

Learn Photography at HOME

Make \$75.00 a Week on the Side
Establish yourself as a Photographer. Expert quickly—during your spare time—under a leading photographer. I'll show you how to start your own business—or command a large salary. Send for my unusual offer—it's only temporary. Act at once. A postal will do.
International Studios, Inc., Dept. 2387
3601 Michigan Ave., Chicago, U. S. A.



WANTED! RAILWAY MAIL CLERKS

Free list of Government Positions obtainable.
Men and Women 17 to 45 years.
Salary \$1600 to \$2600.
Write today for Booklet and list.
UNITED BUSINESS TRAINING ASS'N
807 Dinan Bldg., Detroit, Mich.

Money Making Opportunities

PHOTOGRAPHY AND SUPPLIES

FREE 8"x10" enlargement from your favorite negative. Write for Card "S." Liberty Photo Company, O-We-Go, New York.

HAVE you a camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 156 Camera House, Boston, 17, Massachusetts.

SPECIAL Trial Offer. Any size Kodak film developed for 5c; prints 3c each. Over-night service. Get a Free Auto. Ask for details. Roanoke Photo Finishing Co., 212 Bell Ave., Roanoke, Va.

CAMERA owners: Make your own pictures. Details free. E. L. Burket, Roaring Spring, Pa.

CAMERA Hospital: Expert Camera Repairing a Specialty. Send your broken Camera, will write you Cost. Turner, 1679 Ave. A, New York.

AUTHORS—MANUSCRIPTS

WRITE for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 400, St. Louis.

WRITERS: Stories, poems, plays, etc., are wanted for Publication. Literary Bureau, 117, Hannibal, Missouri.

FREE to writers—a wonderful little book of money-making hints, suggestions, ideas; the A B C of successful story and play-writing. Absolutely free. Just address Authors' Press, Dept. 15, Auburn, New York.

\$\$\$ FOR Ideas. Photoplay plots accepted any form; revised, criticised, copyrighted, marketed. Advice free. Universal Scenario Corporation, 214 Security Bldg., Santa Monica and Western Ave., Hollywood, California.

BIG MONEY in writing photoplays, short stories, poems, songs, etc. Send today for free copy America's greatest magazine for writers. Filled with practical help in writing and selling. Writers' Digest, 636 Butler Building, Cincinnati, Ohio.

BOOKS, PERIODICALS

ENCYCLOPAEDIA Britannica, India paper; half price. Dalton Riggs, Crilly Bldg., Chicago.

DISEASES and their innate healer, 25c. Arthur Stevens, Wauson, Ohio.

"LIGHTS, Colors, Tones and Nature's Finer Forces," including vibrations: odic-auras; cold-lights; radio; inventions; illustrated: 270 pages, \$2.00. Circulars free. Stevens Science Publishers, 242 Powell, San Francisco.

HYPNOTISM Astounds, controls others. Wants gratified. 25 easy lessons, \$1.10. "Mindreading" (any distance), wonderful, \$1.10. Popular Institute, P8 1014, Belmont, Chicago.

MOTION PICTURE BUSINESS

MOTSCO Auto Generator operates on any Automobile or Truck. Produces Electricity for Motion Picture Machines, Theatres, Homes, Tents, Schools, Churches, etc. Full particulars and literature free. Monarch Theatre Supply Co., Dept. 54, Memphis, Tenn.

THEATRE supplies and equipments for sale. Films rented. Particulars free. George Fisher, Coa Cob, Conn.

MOTION picture machines, films, stereopticons. National Equipment Company, Duluth, Minn.

MUSIC AND SHEET MUSIC

POEMS wanted—Sell your song verses for cash. Submit M88, at once or write New Era Music Company, 117, St. Louis, Missouri.

COMPLETE, easy self-instructors—Harmonica, Violin, Piano, Drum, Ocarina, Ukulele, Accordion, Saxophone—25c each. Elser, Publisher, Bowling Green, Ohio.

PROMINENT London music publisher is open for available songs by American writers—amateur or professional; songs judged on merit—not writers' reputations. For further particulars write to American representative, Jack Mahoney, Dept. S., 145 West 45th St., New York.

WRITE the words for a song. We compose music. Our chief of staff wrote many big song-hits. Submit your song-poem to us at once. New York Melody Corp., 419F Romax Building, New York.

CHALK TALKS

LAUGH producing program, \$1.00. Circulars free. Cartoonist Balda, Oshkosh, Wisconsin.

POULTRY AND LIVE STOCK

POULTRY Feeder. New principles. No waste. Sanitary. Booklet and Mash Formula Free. L. Kelly, Saranac Michigan.

STAMPS AND COINS

LIKE Triangular Stamps? To introduce our Sudden Service Approvals we'll send triangular Flume, set China ships, large \$1.00 United States revenue, also packet 50 foreign, millimeter scale, perforation, gauge, ruler and bargain lists—for only 9c. Fennell Stamp Company, Department C, Fullerton Building, St. Louis, Missouri.

158 Genuine Foreign Stamps—Mexican War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc., for only 10c. Finest approval sheets 50% to 60%. Agents wanted. Big 72-p. lists free. We buy stamps. Established 29 years. Hussman Stamp Company, Dept. 55, St. Louis, Missouri.

SEND references for best 60% approvals in America. Norman Shultz, Colorado Springs, Colorado.

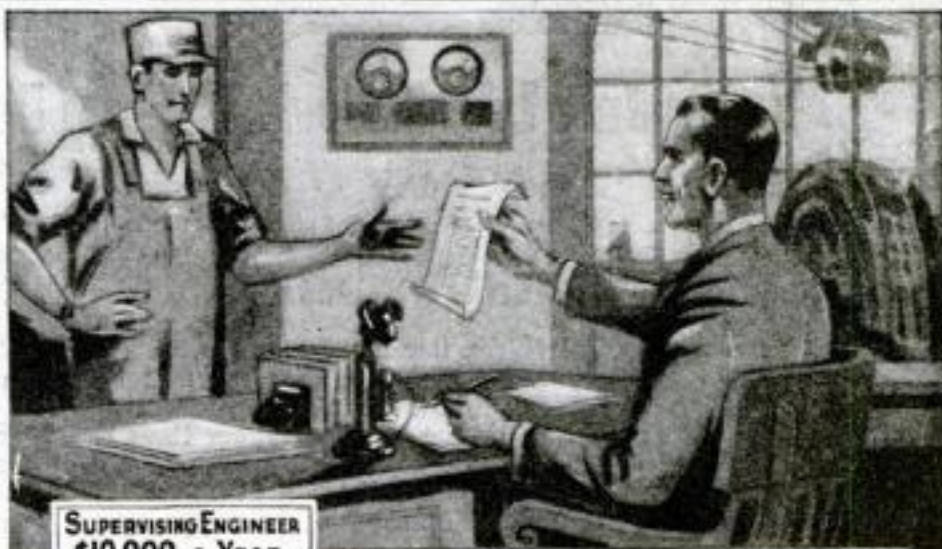
More Money Making Opportunities
on pages 4 to 20

Big Electrical Jobs at Amazing Salaries Given to His Graduates



Never before has there been such a demand for men in the fascinating, Big Pay field of Electricity. And it is for the big supervising jobs that pay the biggest salaries that there is the most need for men. Industry has come to look to S. V. Smith for trained men for these jobs—for his graduates are found to be the most expert—with the thorough knowledge of electricity from the ground up, that is necessary for supervisors, foremen, electrical technicians and equipment managers to have. Even common

ordinary electricians are making big money—but today men trained by Mr. Smith are drawing salaries almost unheard of. Yet Mr. Smith trains men right in their homes by a wonderful



SUPERVISING ENGINEER
\$10,000 A YEAR

NEW EASY WAY to Learn ELECTRICITY—\$500 A MONTH EASY

It is now made possible for any one, regardless of education or experience, to be trained for these big pay jobs. By an amazing new easy system discovered by Mr. Smith it is made possible to give actual shop practice to the student right in his own home. Everything is so clearly explained and so wonderfully illustrated with original cuts, pictures, diagrams, plans and designs—and Mr. Smith's own personal supervision is so thorough that he guarantees your success. It is the only system by which actual shop practice can be given the student in his home.

Every Branch of Electricity

NO matter what you want to learn, you will find it in this wonderful course. You are taught all types of electrical work, such as house wiring (paying \$8.00 a day up); central and sub-station operating and maintenance (\$2500 to \$10,000 a year); automobile and tractor starting, lighting and ignition (\$35 to \$85 per week); electrical jobs and battery station service (\$40 week to \$20,000 a year). You are taught motor maintenance, armature winding, illuminating engineering and line construction. You are fitted to start right out and make good at any of these jobs. But the best thing about this training is that with the thorough knowledge of all these things you are fitted for the jobs at the top of your profession—the big pay jobs that give you the most important positions.

Men Needed

Every day Mr. Smith gets requests for men of this sort and it is only through the Home Study Department of the S. H. Electrical Works that these men can be trained. If you want to get out of the Low Pay rut, study Electricity, as it is the most fascinating and best paying field in the world. And when you enter this profession you cannot afford to be without the prestige and backing of the S. & H. Electrical Works.



Free Outfit

There is such a call for men that Mr. Smith is now offering free a complete outfit of electrical apparatus, instruments and appliances for experimental and practical home work to those who enroll with him immediately. By sending the coupon below you will be entitled to this offer whether you enroll now or later—but you must send it immediately. Now is the time to act—don't take a chance of losing this big free offer and get the information that will open a wonderful career to you. Mail the coupon now.

S. V. SMITH
S. & H. Electrical
Works

Dept. 110

1422 W. Monroe St.
Chicago, Ill.

mail for Free Offer

CHIEF ENGINEER SMITH,
S. & H. Electrical Works, Dept. 110, 1422 W. Monroe St., Chicago, Illinois
Please send me catalog and full particulars of your course in Practical
Electricity and details of your free offer to those who enroll now. I
understand this is free of charge and does not obligate me in
any way.

Name.....
Address.....
City.....
State.....



Just Like a Movie—"From Rags to Riches"
By the Magic of the

Coyne "Job-Method" Drafting Course



Bennett Wellington Cooke
 President of the Coyne School of Drafting, "greatest institution of its kind in the world." Mr. Cooke has an international reputation for turning out big-job big-pay Draftsmen.

ONLY a few months ago an underpaid laborer—or worse, out of a job. Today, a high-priced Draftsman, confident, successful, facing the future without fear. Look at the picture! You'd almost rather be the Draftsman than the BOSS! YOU—no matter what your job today, no matter how limited your schooling—can RE-MAKE yourself by learning Drafting the new way—President Cooke's "Job Method." An every-day occurrence—no magic after all!

Jobs Open \$300 a Month

Every factory, big or little—every railroad, every automotive plant, shipyards, the U. S., State, County, and City governments, the Army and Navy, everywhere you turn Draftsmen are in demand at \$200 to \$300 a month. Before machines, buildings, anything can be built a Draftsman must draw the plans!

Mechanics, Builders

Men in any mechanical line can smash ahead to bigger pay and better jobs when they can not only read blue-prints but create them! "Loan me a part of your spare time"—says President Cooke, "and by my new 'Job-Method' I'll make you an Expert Draftsman quick!" The "Job-Method" gives you actual JOBS to do from the very first "lesson." The "Job-Method" makes hard jobs easy and pleasant.

Mail Coupon for Two Books FREE

The new "Job Method" course of Drafting trains you for the big-pay job. Most complete Drafting instruction ever offered for home study. To supply the enormous demand for Cooke-trained Draftsmen, the great Coyne School now offers special inducements to ambitious men everywhere. Coupon brings 2 free books, and complete information. Mail it today.

COYNE SCHOOL OF DRAFTING
COYNE SCHOOL OF DRAFTING
 B. W. Cooke, President
 Dept. 601
 552-598 So. Throop St., CHICAGO

NEW, Complete Radio Course FREE!

The famous "COYNE" course in Radio, admitted by experts to be the most practical and up-to-date ever produced. Includes construction, installation, operation. Actually teaches you to build your own set. This \$45 course absolutely FREE. Act quick, while this opportunity remains open.

FREE!
 Draftsmen's "Professional" Instruments and complete outfit. Supplied without one cent of cost to every "Job-Method" student. Coupon brings details of this great free offer.

COYNE SCHOOL OF DRAFTING
 B. W. COOKE, President
 Dept. 601
 552-598 So. Throop St., Chicago

Without obligating me in any way please send me your 2 books, "Drafting, the foundation of industry," and "Learning Drafting by the Job-Method"—all absolutely free. Also complete information of your rapid home-study Drafting course, free Radio offer and free instruments.

Name.....
 St. No.....
 City.....
 State.....

FREE FIRST LESSON RECORD

Learn to Play

Violin-Mandolin, and Banjo Mandolin without embarrassment by the World's Most Successful Method. Personal instructions on Records taught by the famous Prof. F. M. Schneider. Six year combined course teaches all three instruments. Simple as A. B. C. Play for money in 2 months. 30,000 have learned to play beautifully.

\$25 Instrument FREE With Course
 Your choice of any one instrument given absolutely free to one pupil in each locality. Only small charge for lessons—a few cents a week. Success assured.

Write Today for Free Record
 Send no money. Just ask for first lesson Record on one week's approval. We want to prove to you as we have to thousands of others the wonderful advantages of learning music the more simple and easy way by our personal instruction lessons given on Records. Write at once! TODAY!

SCHNEIDER SCHOOL OF MUSIC
 Dept. C-10, 238 Vermont St., Blue Island, Ill. (A suburb of Chicago)

HAVE YOU AN INVENTION?

If so the WORLD PROGRESS will show you how to Protect and Profit From Your Ideas
 Sample copy free. One year's subscription \$1.00. Send for free book.

"WHAT TO INVENT"

containing Suggestions to Inventors as to Inventions Needed. We invite manufacturers to address us regarding inventions they want.

WORLD PROGRESS PUB. CO., INC.
 Room 202 Victor Bldg. Washington, D. C.

WRITE JOKES

EARN FROM \$50 TO \$150 PER WEEK
 writing jokes, epigrams and humorous stories for publication. Tremendous demand for material. Our short course in Humor Writing teaches you to write humorous material that sells. Learn in your spare time—earn in your spare time. Complete marketing plan and markets furnished.

AMERICAN INSTITUTE OF HUMOR
 Office K, 414 Park Bldg., Cleveland, Ohio



Money Making Opportunities

STAMPS AND COINS

OLD Coins—large Fall selling catalogue of coins for sale, free. Catalogue quoting prices paid for coins, 10c. William Hessein, 101 B Tremont St., Boston, Mass.

BY Return Mail: Guaranteed Coins: Two Silver, Three scarce Copper and Two over 1500 Years old, for one Dollar. Southampton Coin Exchange, 5427 Nottingham, St. Louis.

STAMPS, 20 unused, All different, 3 cents. Mention paper. Quaker Stamp Co., Toledo, Ohio.

ALL different \$1.10 each. 20 Czechoslovakia, 25 Japan, 20 Liechtenstein, 25 Poland. Fred Onken, 630 79th Street Brooklyn.

CALIFORNIA gold \$ 1/4 size, 27c; \$ 1/2 size, 53c. White cent and catalogue. 10c. Norman Schults, Colorado Springs, Colorado.

STAMPS free! 24 British Colonials to approval applicants. Nickles, 122 Florida, Washington, D. C.

100,000 RUBLES, 25c. 10,000 German marks, \$1.00. Craig Dare, 440 55th, Brooklyn, New York.

1000 Different Stamps \$1.55; 500 55c; 300 27c. Michael 5353 Calumet, Chicago.

17 VARIETIES Bulgaria stamps, 20 cents. List of 7,000 low-priced stamps free. Chambers Stamp Company, 111C, Nassau Street, New York City.

FREE—14 Ukraina, to (50%) approval applicants only. Lampe, 423 West 42nd, New York.

FREE premium to approval applicants sending 2c. Price list free. Richard Lamprecht, Dept. M, Valparaiso, Ind.

STAMPS—50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10c. 50 different U. S. 25c. 1,000 hinges, 10c. 1,000 mixed, 40c. List free. C. Stegman, 5949 Cote Brillante, St. Louis, Missouri.

PACKETS of merit—1,000 all different stamps, \$1.40; 500, 65c.; 200, 18c.; 100, 8c.; 50 different French Colonies, 25c.; 50 Port. Colonies, 25c.; 50 British Colonies, 20c.; 100 Hungary, 15c.; 200 Hungary, 45c.; 25 Czechoslovakia, 15c.; 300 Neurope 45c. Yonkers Exchange, Yonkers, N. Y.

FOR INVENTORS

INVENTORS' educator. 900 mechanical movements, 50 perpetual motions. How to procure and sell patents. Mechanical movements greatly assist inventors, suggest new ideas. Explains how to select an attorney and avoid patent sharks. Price \$1.50. Postage free. Albert E. Dietrich, 681 Ouray Building, Washington, D. C.

THE G. & G. Manufacturing Company, 3116 Spring Grove Avenue, Dept. A, Cincinnati, Ohio. Special machinery, models, dies, patterns, tools, metal stampings, gears, contract manufacturing.

PATENTS—Write for Free Guide Book and Evidence of Conception Blank. Send model or sketch of invention for free opinion of its patentable nature. Highest references. Reasonable terms. Victor J. Evans & Company, 156 Ninth, Washington, D. C.

INVENTORS—Send your ideas for manufacturing development to our modern sheet metal and angle-iron fabricating plant. Those pertaining to dust collecting or ventilating preferred. Liberal payment for accepted inventions. Kirk & Blum Manufacturing Co., 2845 Spring Grove Ave., Cincinnati, Ohio.

I SELL patents. Established in 1900. Charles A. Scott, 773PS, Garson Avenue, Rochester, New York.

To sell your patent, write me. Experienced handling, immediate action. Address Arthur S. Billings, Suite 401 Dekum Bldg., Portland, Oregon.

INVENTORS write for free copy of Modelcraft, R. G. Clyne, St. Louis, Mo.

UNPATENTED Ideas can be sold. I tell you how and help you make the sale. Particulars free. Write W. E. Greene, Jenifer Building, Washington, D. C.

INVENTIONS commercialized. Patented or unpatented. Write Adam Fisher Mfr. Co., 183 St. Louis, Mo.

PATENT ATTORNEYS

*** PATENTS—Before disclosing an invention the inventor should write for our blank form "Record of Invention."** This should be signed, witnessed and returned to us together with model or sketch and description of the invention and we will give our opinion as to its patentable nature free. Our Three Books mailed free to inventors. Our illustrated Guide Book, "How to Obtain a Patent" contains full instructions regarding patents. "List of Patent Buyers" sent free, contains unsolicited letters from manufacturers and others who are constantly writing us regarding the purchase or leasing of meritorious patents. Victor J. Evans & Co., 937 Ninth, Washington, D. C.

INVENTORS—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Allwine 232 Ouray Bldg. Washington, D. C.

MONROE MILLER, Ouray Building, Washington, D. C., patent attorney, mechanical and electrical expert. Best quality of work and results. Moderate charges.

PATENTS, trade marks, copyrights. Prompt, personal, reliable service. Over 30 years' active practice. Write for terms. Book free. Address E. G. Siggers Box 1, N. U. Building Washington, D. C.

PATENTS. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F Street, Washington, D. C.

PATENTS procured and trade marks registered. Advice and terms upon request. Robb, Robb & Hill, 1336 Hanna Building, Cleveland, Ohio. 840 McLachlen Building, Washington, D. C.

BEFORE or after filing application for patent on your invention it will pay you to read over my "Inventors' Adviser No. 1," free for asking. M. Labiner, Registered Patent Attorney, 3 Park Row, New York.

HERBERT JENNER, patent attorney and mechanical expert, 624 F Street, Washington, D. C. I report if patent obtainable and exact cost. Send for circular.

LACEY Patent-Sense. "The book the inventor keeps." Free. See page 112.

PATENT applications filed on partial payment plan. Trade-marks; copyrights. Milo B. Stevens & Co., 640 F St., N. W., Washington, D. C.

PATENTS PROCURED; trade marks registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington, D. C., or 2276-Z Woolworth Bldg., New York.

More Money Making Opportunities on pages 4 to 20

"THE WORLD NEEDS ENGINEERS

—and is willing to
reward them with
honors, fame and money"



RALPH R. ARNOLD, County Engineer
Contra Costa County, California



In the beautiful Court House
of Contra Costa County are
located the offices of Engineer
Ralph R. Arnold, the man who
mixes concrete with brains.



Section of Franklin Canyon Road, a 24-
foot highway constructed by Engineer
Arnold for the price of an 18-foot high-
way. Note unique arrangement of concrete
with 4 feet of macadam in between. The
macadam is slightly raised, insuring safety.

WHEN Ralph R. Arnold says that "the world needs engineers," it means something. For Ralph R. Arnold is County Engineer of Contra Costa County, California, and builder of the famous Franklin Canyon Road.

"Engineers are in demand," said Mr. Arnold the other day. "It is becoming harder and harder to get trained men.

"Very often, when a board of directors discusses the necessity of having some engineering work done, it is not a question of expense, but 'where can we find the man?'

"This is a regrettable state of affairs from an economic standpoint, perhaps, but it offers big opportunities for the trained man.

"Too many young men simply drift along in some routine work that doesn't interest them. Every man ought to soberly face the facts, and ask himself—'Do I want to make this my life's work?'

"If there is any formula for success it is this: Decide early in life what you are going to be. Study every angle of that business or profession. Get into the business in a practical way as soon as possible. Then 'work like the dickens' and continue studying.

"Maybe I lay too much emphasis on study, but I don't think so. The hours I spent at home studying my I. C. S. course meant so much to me that I'm naturally enthusiastic. With present day facilities for studying by correspondence there is absolutely no excuse for a man not being a success. Why, even to-day I refer to my old I. C. S. instruction papers several times a week on some particular problem. That shows how practical they are!"

MR. RALPH R. ARNOLD is only one of thousands upon thousands of men who have started from nothing and won their way to the high places by sheer grit and spare-time study.

If you will supply the will the International Correspondence Schools will supply the way.

For it is the business of the I. C. S. to prepare men and women for bigger jobs and larger salaries—in engineering, in architecture, in advertising, in salesmanship, in more than 300 other lines of work.

At least find out how, by marking and mailing the same coupon that has meant so much to so many other men just like yourself. It doesn't obligate you in any way to do this—it takes only a moment—but it may be the means of changing your entire life for the better. Why not do it now?

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 7636-C, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject before which I have marked an X:

BUSINESS TRAINING COURSES

- | | |
|---|---|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Advertising |
| <input type="checkbox"/> Personnel Organization | <input type="checkbox"/> Better Letters |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Foreign Trade |
| <input type="checkbox"/> Business Law | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Banking and Banking Law | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Accountancy (including C.P.A.) | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Nicholson Cost Accounting | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Common School Subjects |
| <input type="checkbox"/> Private Secretary | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Business Spanish <input type="checkbox"/> French | <input type="checkbox"/> Illustrating |

TECHNICAL AND INDUSTRIAL COURSES

- | | |
|---|--|
| <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Architect |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Blue Print Reading |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Contractor and Builder |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Architectural Draftsman |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Concrete Builder |
| <input type="checkbox"/> Railroad Positions | <input type="checkbox"/> Structural Engineer |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> Chemistry <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Automobile Work |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Airplane Engines |
| <input type="checkbox"/> Metallurgy <input type="checkbox"/> Mining | <input type="checkbox"/> Agriculture and Poultry |
| <input type="checkbox"/> Steam Engineering <input type="checkbox"/> Radio | <input type="checkbox"/> Mathematics |

Name.....
Street.....
Address.....
City..... State.....
Occupation.....
Persons residing in Canada should send this coupon to the
International Correspondence Schools Canadian, Limited,
Montreal, Canada.



If He Had Passed It Up

He Would Still Be A Laborer At \$2 A Day. No Money, Nothing Ahead But Hard Work, Longer Hours—And Regrets. But He Didn't Pass It Up

He decided to learn Mechanical Drawing. He buckled down to work with the Columbia School of Drafting. When he had a quiet half hour to spend he spent it—as a wise man spends money—to get full returns.

MADE \$275 EXTRA IN 3 DAYS. He recently received \$275 for one drawing that only took him three days to draw.

NOW HOW ABOUT YOU? Are you working up hill or down? Count the money in your pay envelope next pay day. You'll find the answer there.

MAKE \$35 TO \$100.00 A WEEK. We will train you to be an expert Draftsman in your spare time at home by mail. There's lots of room for you if you act now.

PROMOTION IS QUICK. WE'LL QUALIFY YOU for a high-salaried position in the drafting field and keep you in touch with openings for Draftsmen in the big machine shops, industrial plants and United States Government departments. Men who start as Draftsmen are often advanced to Chief Draftsmen, Chief Engineers, Production Managers and so on.

GET THE RIGHT TRAINING. Mr. Claffin, the founder and director, stands personally in back of the Columbia School of Drafting. You spend no time in long-winded theories—useless and expensive to you. You start on actual drawing work the day you receive your first lesson.

YOU NEED NO PREVIOUS TRAINING. The course is easy to understand and easy to follow. Many students are qualified even before they complete the course.

SUCCESS CALLS MEN OF ACTION ONLY. If you are a man of action clip the coupon now and show that you are a man of action. Keep right on top of this opportunity to make real money. Don't go looking for a pair of scissors. Tear the coupon off and mail it right now. We have a special offer for those who reply promptly. Get started now.

WHAT WE GIVE YOU

PRACTICAL PROBLEMS. You are carefully coached in practical Drafting work.

WE HELP YOU GET A JOB. We help you get a po-

FREE Drafting Outfit



We give you Free, with our course, this professional Drafting outfit. It is yours to keep when you complete the course.

sition as a practical Draftsman as soon as you are qualified. **PERSONAL INSTRUCTION AND SUPERVISION THROUGHOUT THE COURSE.** You receive the personal instruction and help of Roy C. Claffin, president of the Columbia School of Drafting and a practical Draftsman of many years' experience.

DRAFTSMAN'S EQUIPMENT. We furnish you with a full set of Drawing Equipment and Drafting Instruments as shown in the picture below when you enroll. You keep both sets on completing the course.

CONSULTATION PRIVILEGES. You are free to write us at any time for advice and suggestions regarding your success.

DIPLOMA. The diploma we give you on completing the course attests to your proficiency as a Draftsman. It is an "entering wedge" to success.

FREE SUBSCRIPTION TO DRAFTSMAN'S PUBLICATION "THE COMPASS." You are given free a subscription to our helpful, inspiring publication "The Compass."

U. S. CIVIL SERVICE COMMISSION NEEDS DRAFTSMEN

The following are a few of the many positions open in Government Departments from time to time. The salaries are starting salaries, subject to increase. Practically all of them carry a bonus of \$240 a year additional.

Architectural Designer \$4,000
Chief Draftsman (Aeronautical) Naval Aircraft
Factory—\$15.04 per day.
Aeronautical Draftsman—Field Service of Navy
Department—\$5.20 per day to \$12 per day.

FREE BOOK Send in this coupon today, immediately on receipt of it we will send you our book "Drafting—Your Success" which tells you all about our new method of teaching Mechanical Drawing and gives full details of our special offer to those who reply promptly.

THE COLUMBIA SCHOOL OF DRAFTING

Roy C. Claffin, President
Dept. 2123, 14th & T Sts., N. W.
Washington, D. C.

Money Making Opportunities

PATENT ATTORNEYS

MILLIONS spent annually for ideas! Hundreds now wanted! Patent yours and profit. Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. 501 Kresge Bldg., American Industries, Inc., Washington, D. C.

H. F. Lowenstein, registered patent attorney. Technical expert. 817 McLaughlin Building, Washington, D. C.

EDWARD C. SARNETT, formerly a Principal Examiner U. S. Patent Office. Personal Service. 530 McGill Bldg., Washington, D. C.

INVENTORS' Guide free on request; gives valuable information and advice for all who have original ideas or improvements. Frank Lederman, Registered Attorney and Engineer, 15-3 Park Row, New York.

INVENTORS: Record invention legally before disclosing to others. Our invention-record and data-sheet shows how. Sent free and valuable information given on patent procedure, costs, etc. Report on patentability includes copies of patents nearest your idea. O. Connell & O. Connell, 401 Jenner Building, Washington, D. C.

PATENTS—My fees in installments. Advice book free. Frank Fuller, Washington, D. C.

DISTRICT MANAGERS WANTED

WORLD'S fastest selling auto accessory! County distributors wanted; write today. G. L. W., Spring Oiler Co., San Diego, California.

DISTRICT Managers. Big profits. Men capable of organizing and managing crews of lady solicitors can easily clear \$50 to \$100 per week with the B. & G. Protector, the original and best protector on the market. Every woman between fifteen and fifty needs and buys it. B. & G. Rubber Co., 618 Penn Avenue, Pittsburgh, Pennsylvania, Dept. 447

AGENTS AND SALESMEN WANTED

BIG Money in spare time for one man in each locality making embossed show cards and price tickets for stores and others. Easy, quick work. No training needed. New embossing machine does it all. 400% profit. Signs sell on sight. T. W. Cushing of Chicago sold \$76 first call. S. D. Downes averaged \$15 a day for 6 months. Many sell \$5 to \$20 daily. No speculation. Before you invest a penny we send you free sample cards to show merchants and convince yourself they sell at sight. Write today. Praemafix Corporation of America, Dept. 400, Geneva, New York.

AGENTS—Best seller: Jem Rubber Repair for tires and tubes; supercedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

GET our plan for monogramming automobiles, trucks, hand luggage and all similar articles by transfer method experience unnecessary; exceptional profits. Motorists' Accessories Company, Mansfield, Ohio.

ONLY one sale a day means \$200 per month! Five sales \$1,000 per month. Marvelous new adding machine. Retail \$15.00. Work equals \$350 machine. Adds, subtracts, multiplies, divides automatically. Speedy, accurate, durable, handsome. Five year guarantee. Offices, stores, factories, garages buy one to dozen. A fortune for live agents. Write quick for protected territory and free trial offer. Lightning Calculator Co., Dept. P, Grand Rapids, Michigan.

\$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Out its furnished. Write Gunmetal Co., Ave. F, Decatur, Illinois.

MAKE \$25 to \$50 week representing Clows' Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clows Company, Desk 24, Philadelphia, Pennsylvania.

GREATEST sensation! Eleven piece toilet article set selling like blades at \$1.75 with \$1.00 dressmaker's shears free to each customer. Spring rush on. Foster Reid Co., 37 Winslow Bldg., Station C, Chicago.

HERE'S a business requires only table room. We start and help build business. Work for us painting landscape photo print pictures. No experience. We furnish outfit. Free literature. Tangley Co., 195 Main, Muscatine, Iowa.

GET our free sample case toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F, St. Louis, Missouri.

\$100 weekly. Agents, crew managers. Absolutely new article selling big to housewife. No capital required. Commissions paid in advance. No collections. No delivery. Exclusive territory. Write quick. Pioneer Corp., 6307 Yale Avenue, Chicago, Illinois.

AGENTS—Make a dollar an hour. Sell Mendota, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Company, Dept. 467, Amsterdam, New York.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Particulars free. Stalbrit Company, 1115 Second Avenue, New York.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50; make \$1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

SELL necessities. Everybody needs and buys the "Business Guide." Bryant cleared \$800 in July. Send for sample. It's free. Nichols Company, Box 1B, Naperville, Illinois.

BIG fast profits for agents. Repeater Six Fuse Plugs sell on sight wherever there is electricity. Do away with lighting troubles. Welcomed everywhere. Get details. Sample 25c. Moss-Schury Manufacturing Company, Inc., 15-A, Detroit, Mich.

More Money Making Opportunities
on pages 4 to 20

FREE BOOK COUPON

COLUMBIA SCHOOL OF DRAFTING,
Dept. 2123, 14th & T Sts., N. W.,
Washington, D. C.

Enter my name for a free subscription to "The Compass" and also send me without charge your illustrated book on Drafting, telling me how I can secure your complete Home Study Course and your help in securing a position as Draftsman.

Name.....
Address.....
City..... State.....

Learn Cartooning

At Home—In Your Spare Time

from the school that has trained so many successful cartoonists of today earning from \$50 to \$200 and more a week. The Landon Picture Chart Method of teaching makes original drawing easy to learn. Send 6c in stamps for full information and chart to test your ability. Also state age.

THE LANDON SCHOOL
1451 National Bldg., Cleveland, O.



"STAMMERING"

Its Cause and Cure

You can be quickly cured if you stammer. Send 10 cents, coin or stamps, for 288 page cloth bound book on Stammering and Stuttering. It tells how I cured myself after Stammering and Stuttering for 20 years. BENJAMIN N. DOGUE, 698 Beque Bldg., 1147 N. III St., Indianapolis

SELL YOUR SPARE TIME

US

You can earn \$15 to \$50 a week writing show cards in your own home.—No canvassing.—A pleasant profitable profession easily and quickly learnt by our new simple graphic block system. Artistic ability not necessary.—We teach you how, and supply you with work—Distance no object. Full particulars and booklet free.

WILSON METHODS LIMITED—DEPT. C
64 East Richmond, Toronto, Canada.

BE A TRAFFIC MAN

DEMAND INCREASING DAILY

With the energetic revival of business activities, the demand for men trained to handle transportation problems is greater than ever before. Our highly specialized course prepares you for this high salaried profession. Personal attention and practical experience—with successful Traffic Men. Special plan to help pay your tuition. Post graduate course FREE. Write today for full information.

INTERSTATE TRAFFIC SCHOOL
210 Traffic Bldg. Fort Wayne, Ind.

Tighten Your Grip on a Trade

Be An Electrical Expert At \$75 to \$200 a Week

Every up-to-date fellow knows what a future there is in electricity.

Big pay—fascinating work on land or sea—rapid advancement in a field where jobs are ten times more numerous than trained men to fill them, where \$75.00 a week is just a fair starter, where top notchers pull down ten thousand dollars or more a year—in a field, where any man if he wishes, can easily have a business of his own, have men working for him, **be his own boss!**

But what the average young man does NOT know, is what a simple, easy, A-B-C sort of a job it is to get started.

You Can Start Right Now!

Yes, you. You don't need a thing you don't already have! You can read. You can write. You can figure. You can think. And in your breast is the fire of ambition—the desire to get ahead! All right, that's all you need—we can help you just as you are—just as we have helped scores, yes, thousands of other two-fisted young fellows determined to get out of the rut and into the electric field—into work that will be pleasant—easy—and all in your home, during spare time.

Fascinating Home Study As You Hold Your Old Job

With the help we will give you, you can slip right into one of these big pay—he-man jobs and never lose a day's work. After a few weeks' start, you can earn enough in installation and electric repair jobs alone to more than pay for the Course and lay a foundation for an Electrical Contracting or Repair Shop Business of your own. When the proper time comes, we will tell you the easy way to go about doing it.

The Most Practical, Thorough and Condensed Electrical Course Ever Written

This is the only home study electrical course that gives you the combined practical and theoretical training you must have before you can be a successful electrician without which you cannot succeed—with which you cannot fail.

Written not by ONE man, with the narrow one-man viewpoint, but by 22 of the brainiest, most successful, electrical experts ever drawn from the field of practice and theory. Gives you the complete mastery of the subject—qualifies you as electrical expert to boss jobs—fits you right into the kind of a job you want—and does it in shortest time—at lowest cost—with the

Most Binding Guarantee of Results Ever Offered!

Satisfaction guaranteed or no sale! We not only SAY we can make you an electrical expert, we Guarantee it! If you are not absolutely satisfied when you have finished our Practical Electrical Course, we will refund every nickel you sent us.

FREE!

Experimental Outfit Worth \$30
Drafting Course Worth Another \$30
Big Electrical Library Worth \$25

Find out all about our offer. Find out about the thousands who have taken this course in preference to

all others and MADE GOOD. Find out about the Electric Library—four elegant volumes—worth \$25, but free. About the free Drafting Course worth another \$30. The free Experimental and Demonstration Outfit, including a real, not a make-shift Electric Motor, Wheatstone Bridge, etc.—the most scientific, high-grade and complete Experimental Outfit ever supplied with a Course in Electricity. Get all the facts without obligation, without expense! Just send the coupon!

American School

Dept. E-775

Drexel Ave. and 58th Street, Chicago

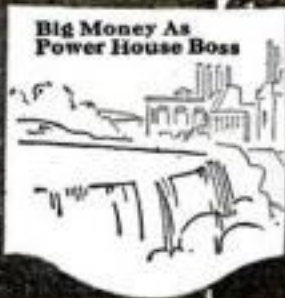
FREE Electrical Coupon

American School,
Dept. E-775, Chicago

Please rush all information relative to your Course in Electricity. This obligates me in no way whatever.

Name.....

Address.....



Little Mistakes In English Make Others Judge You Unfairly

Does your English reveal your lack of education or does it prove that you are a person of culture and refinement? English is the one weapon you must use every day. Here is how you can improve it almost at once.



SHERWIN CODY

You are sized up every day by what you say and write. The words you use, how you use them; your spelling, grammar, punctuation—these tell the measure of your ability, your experience, your breeding, more clearly than anything else. Your English says to all the world, "This is what I am!"

How Poor English Hurts You

English is the advertisement of your ability. Your language determines your position in the social and business scale. Charming personality, fine clothes, wonderful appearance, count for little if handicapped by imperfect or "sloppy" English.

People will think you are lacking in education and culture if you spell incorrectly such common words as "business," "abbreviate," etc.; if you say "between you and I" instead of "between you and me;" if you use "who" for "whom" and "shall" for "will." What can you expect people to think if you don't know when to use one or two "c's" or "m's" or "r's," or when to use "ei" or "ie," or if you say "hospitable" when you should say "HOSPitable." Fairly or unfairly, everybody everywhere judges you the same way. Poor English is an unnecessary handicap.

15 Minutes a Day Perfects Your English

If your English does not make people think the best of you then it must be improved. Extensive tests show that most men and women are but 61% efficient in the essential points of English.

But now there is a way to improve your English. Sherwin Cody, perhaps the best-known teacher of practical English, has perfected and patented a remarkable device which quickly gives you a commanding mastery of English. He has thrown aside all the "junk" which makes the old methods so inefficient. The drudgery of rules and tiresome drills is discarded. Each evening you are assigned an easy 15-minute lesson. No time is wasted on what you already know. You are quickly shown your mistakes in spelling, punctuation, grammar, and pronunciation, and you concentrate on the points that need attention. By actual use correct English soon becomes a habit.

Astonishing Book on English Sent Free

A command of polished and effective English denotes education and culture. It wins friends and makes a favorable impression upon those with whom you come in contact. In business, as well as in social life, correct English gives you added advantages and better opportunities while poor English handicaps you more than you will ever realize. And now, in only 15 minutes a day—in your own home—you can actually check up and see yourself improve by using the 100% self-correcting method.

If you are efficient in English it will give you greater confidence; if you are deficient you sorely want to know it. For this reason Mr. Cody has prepared a simple 15-minute test which you can take in your own home. The correct answers are given so you can tell at once just where you stand. Write today for this test—it is free. We will also gladly mail you our new free book, "How to Speak and Write Masterly English." Merely mail the coupon or a postal card. Free yourself of the embarrassing errors in English that make you feel ill at ease. You can never achieve your greatest possibilities until you master English. Write today.

SHERWIN CODY SCHOOL OF ENGLISH
1810 Searle Building Rochester, New York

SHERWIN CODY SCHOOL OF ENGLISH
1810 Searle Building, Rochester, New York
Please send me your new Free Book, "How to Speak and Write Masterly English," and also the 15-minute Test.

Name.....
Address.....
City..... State.....

Money Making Opportunities

AGENTS AND SALESMEN WANTED

EVERYBODY uses extracts. Sell Duo Double Strength Extracts. Complete line household necessities. Big repeaters. Write today. Duo Co., Dept. E66, Attica, N. Y.

INSTANT Rubber Weld—Repairs largest punctures without cement or heat. Lem's profit one day \$56. Write quick. Free sample. Territory going fast. Tourist's Pride Mfg. Co., Desk R, Minneapolis, Minnesota.

EARN Big Money Fast applying gold initials to Autos. Every owner buys—\$1.35 profit on \$1.50 sale—particulars and samples free. Write quick. Lithogram Co., Dept. 30, East Orange, N. J.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

POLMET polishing cloth cleans all metals; sells fast at 25c. Sample free. F. C. Gale, 15 Edinboro St., Boston.

AGENTS: Big money selling Clean-em, crystal washing marvel. Sample free. H. H. Shields, 1938 Telfair St., Augusta, Ga.

FORMULAS, trade secrets—Different, dependable. Catalog free. C. Thaxby Co., Washington, D. C.

WONDERFUL Invention—Eliminates all needles for phonographs. Saves time and annoyance. Preserves records. Lasts for years. 12,000,000 prospects. \$15.00 daily. Free sample to workers. Everplay, Desk 1026, McClurg Bldg., Chicago.

SALESMEN, secure exclusive protected territory, high class, permanent business, worth \$10,000 yearly. Only small capital needed, no risk. Address Box 1336, New Haven, Conn.

\$742 LAST month for Beck, of Buffalo, introducing latest advertising plan; nothing else like it; every merchant wants it; easy sales; no deliveries; no collections; specialty salesmen write quick for offer. National Adv. Service, P. O. Box 39, LaGrange, Indiana.

AGENTS: Big profits, no competition. Make \$5.00 to \$15.00 daily selling our beautiful Scripture Text Calendars. Agents now selling from 10,000 to 50,000 yearly. Write now. Messenger Pub. Co., Dept. 140, 314 West Superior St., Chicago, Illinois.

AGENTS. Everywhere. Sell shoes direct to wearer. Quality guaranteed. We deliver. A. C. Condon, Sales Manager, The Allen Shoe Co., 110 Summer Street, Boston, Massachusetts.

50% PROFIT selling name cards, penknives, stationery, catalog. Wolf Labels, Station E, Philadelphia.

SELL Madison "Better Made" shirts direct from our factory to wearer. No capital or experience required. Easily sold. Big profits. Write for free samples. Madison Mills, 503 Broadway, New York.

EARN \$10 daily silvering mirrors, plating and refinishing metalware, headlights, chandeliers, bedsteads. Outfits furnished. F. Decie Laboratories, 1133 Broadway, New York.

PHOTO medallion salesmen. Earn \$100 to \$200 every week selling P. & G. Photo Medallions. No investment—free equipment. Guaranteed 4 day service—send for sales plan and free 1923 catalogue with 102 beautiful designs including clock and religious medallions. Pudlin & Goldstein, 259 Bowery, Dept. M, New York.

BIG money in the sale of stock for the Southern Chemical Company. Write for particulars to the Arkansas Products Company, Cardwell, Missouri.

AGENTS Wanted—"10 A Day And More," our new book, shows clearly how you may gain sure success and large profits selling Guaranteed Hosiery and Underwear. Factory to family. It is Free. Write today. C. & D. Company, 25-E, Grand Rapids, Mich.

SALESMEN:—Become independent without risking your capital. Build your own business in your spare time by holding your present position, selling Accident-Sickness benefits. Costs \$10.00 yearly, with guaranteed steady income from renewals. Experience unnecessary. Write quick. United Department, Newark, New Jersey.

SHEEP wool moccasins, polishers, dusters. Box 26, East Boston, Mass.

AGENTS make 500% profit handling auto monograms, new pictures, window letters, transfer flags, novelty signs. Catalog free. Hinton Co., Dept. 125, Star City, Indiana.

STAMPING names on emblem key checks. Sample 20c. Key check outfits, steel dies, key cases, etc. Service Sales Corporation, Shelby, Ohio.

AGENTS—Stop wishing; work; you can make \$10.00 daily selling articles everybody needs. Particulars free. Write B. & G. Rubber Company, Dept. 446, Pittsburgh, Pennsylvania.

WANTED—Tailoring salesmen, make \$60 to \$125 per week. Biggest merchants in many towns have started with our lines. We are the largest made-to-measure tailoring house in the country, furnishing elaborate sample equipments, including 500 all wool fabrics and guaranteed absolute satisfaction, perfect fit, best workmanship, or no sales. Write me for line and all accessories to be sent free. Tell us all about yourself. Address G. H. Shayne, Sales Manager, Box 483, Chicago, Illinois.

AGENTS—15 a day—Easy, quick sales—Free auto—Big weekly bonus—\$1.50 premium free to every customer. Simply show our beautiful 7-piece, solid aluminum handle cutlery set. Appeals instantly. We deliver and collect. Pay daily. New Era Mfg. Co., 803 Madison Street, Dept. 41P, Chicago.

\$60-\$200 A WEEK. Genuine Gold Letters for store windows. Easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434A North Clark, Chicago.

\$5 to \$15 DAILY easy—Introducing New Style Guaranteed Hosiery. Must wear or replaced free. No capital or experience required. Just show samples, write orders, we deliver and collect. Your pay in advance. Elegant outfit furnished, all colors—grades including silks, wool, heathers. Mac-O-Chee Mills Company, Desk 15210, Cincinnati, Ohio.

MAKE \$31.00 Profit—Cost you \$1.50 Complete Gold Monogramming Outfit. Transferred instantly on Automobiles, Trunks, Bags, Windows. Experience Unnecessary. "Free Samples." Nullife (B) Monogram, Hartford, Conn.

AGENTS—Clever Invention! Inkspoon makes every pen a fountain pen. Fast office seller; big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Building, New York.

More Money Making Opportunities
on pages 4 to 20



Be a MUSICIAN In Half Usual Time

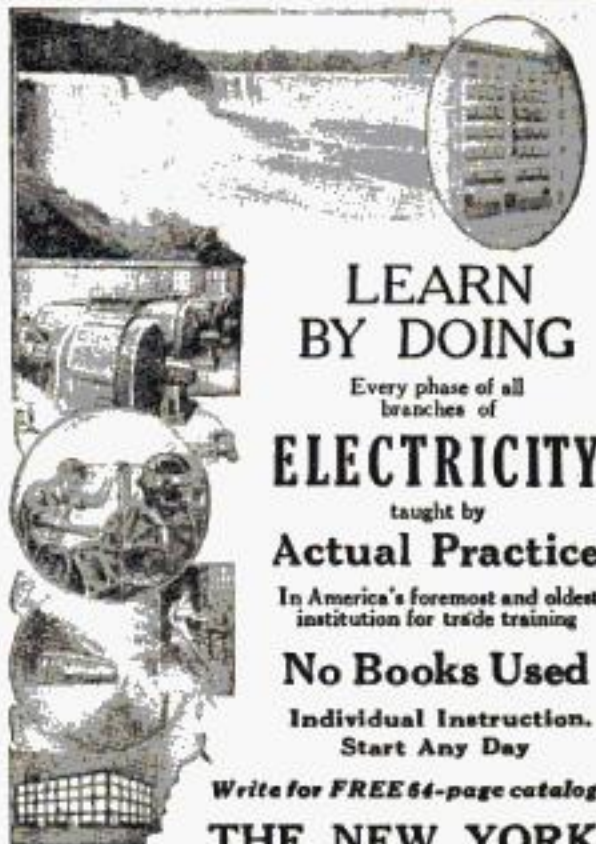
Amazing new method gives you musical skill so quickly that one delighted student says "It's like being made a musician while you wait!" You learn by

PLAYbyNOTE
Piano, Organ,
Violin, Cornet,
Mandolin,
Harp, Cello,
Trombone,
Flute, Clarinet,
Piccolo,
Saxophone,
Ukulele, Guitar,
Harmony and Composition,
Banjo, Tenor Banjo,
Voice and Speech Culture, Drums and Traps, Automatic Finger Control, etc.

playing actual musical compositions right from the start—instead of tiresome exercise. As simple as A, B, C, and as enjoyable as a game. Learn at home, by mail.

FREE BOOK AND SAMPLE LESSON SHOW HOW

All about the special offer on rapid course that makes you master of your favorite instrument. It shows how to surprise your friends by playing before they suspect you've started to learn. It explains our new invention "Automatic Finger Control"—the musical wonder of the century—whereby your fingers are trained and guided until they fall in place almost automatically. Nothing like it ever known before. **WRITE NOW.** There is no obligation to buy anything. But act today—before these free books and sample lessons are exhausted. Instruments supplied if desired, cash or credit. Address U. S. School of Music, 810 Brunswick Bldg., New York City.



LEARN BY DOING

Every phase of all branches of

ELECTRICITY

taught by

Actual Practice

In America's foremost and oldest institution for trade training

No Books Used

Individual Instruction.
Start Any Day

Write for FREE 64-page catalog

**THE NEW YORK
ELECTRICAL SCHOOL**
40 West 17th St., New York City

Free to Writers!



A WONDERFUL BOOK—read about it! Tells how easily stories and plays are conceived, written, perfected, sold. How many who don't DREAM they can write, suddenly find it out. How the Scenario Kings and the Story Queens live and work. How bright men and women, without any special experience, learn to their own amazement that their simplest ideas may furnish brilliant plots for plays and stories. How one's own imagination may provide an endless gold-mine of ideas that bring Happy Success and Handsome Cash Royalties. How new writers get their names into print. How to tell if you ARE a writer. How to develop your "story fancy," weave clever word-pictures and unique, thrilling, realistic plots. How your friends may be your worst judges. How to avoid discouragement and the pitfalls of failure. **How to Win!** This surprising book is absolutely free. No charge. No obligation. Your copy is waiting for you. Write for it now. Just address **AUTHORS' PRESS, Dept. 206, AUBURN, NEW YORK**



Learn to Write

Begin Today—Write for My FREE BOOK
I can make a good penman of you at home during spare time. Write for my FREE BOOK, "HOW TO BECOME A GOOD PENMAN." It contains specimens and tells how others mastered penmanship by the Tamblin System. Your name will be elegantly written on a card if you enclose stamp to pay postage. **FREE BOOK—Write for It Today.**

F. W. Tamblin, 437 Ridge Bldg., Kansas City, U. S. A.

How much money do inventors make—or lose?

Raymond Francis Yates

American Society of Mechanical Engineers

American Institute of Electrical Engineers

Institute of Radio Engineers

American Physical Society

OVER 70,000 patents were allowed in this country last year, but only about 3500 had any real commercial value. Most of the 3500 practical inventions were developed by professional inventors, while most of the impractical inventions were the work of "free-lance" inventors—men and women who suddenly decided that they had an idea for an invention, and immediately set about to perfect it.

Of course there must be some reason why the trained inventor is so uniformly successful in his inventions, while the untrained inventor so often fails. Probably the greatest cause is that most people believe invention to be a "hit or miss" proposition—an out-and-out gamble. That is why so many would-be inventors waste years of effort, eat deep into their savings to work on inventions which can never bring them a penny, why still others who do produce worthwhile inventions lose their rights in them or receive only a pittance for their hard work.

What Invention Is

It doesn't require much thought to see that invention cannot be a matter of pure luck. Neither is it, as some people seem to think, something which only a genius can do. As a matter of cold fact, invention—successful invention—is nothing more or less than the careful, methodical use of certain fundamental facts, which anybody can learn easily.

It may seem strange to you that invention can be learned exactly as you learned reading, writing and arithmetic. Yet proof of this is easy. You will admit that if, as I have said, invention can be studied like any other profession—like mechanics, law, book-keeping, medicine—then those who do learn it should be able to produce many different kinds of inventions.

Of course you are familiar with Edison's inventions. Here are additional examples of less known inventors. Christopher N. Spencer first invented the breech-loading repeating rifle, which he followed by inventing the thread-spooler, the automatic turret-lathe, the automatic screw-machine, the "pump action" repeating rifle. He was also part-inventor of the drop hammer. B. T. Babbitt, of soap fame, invented the process of wrapping and pressing laundry soap in cakes, besides inventing the first commercial baking powder, floating white soap, commercial chemicals, and several railroad devices. Henry Gaisman, inventor of the Auto-Strop Safety Razor, is also the inventor of the Autographic Kodak which he sold outright for \$300,000.

How Inventions Are Made

That, you will agree, answers the question: "How much money do inventors make—or lose." If the inventor *knows* what he is doing, if he has studied the principles of invention and uses them, he is bound to make money. But if the would-be inventor merely takes a chance without any real

thought of what he is doing or how to do it, the chances are a hundred to one that he won't make a cent.

However, Inventive Science is easy to learn, because everybody—every man, every woman—is born with the inventive instinct. You will understand better what I mean when you realize that an invention is only a device which "fixes" or improves something.

All inventions are made just this way. First some need is seen and recognized—new amusements, better light, better power, cheaper transportation, better automobile accessories—any one of a thousand needs which are impressed upon you every day. The next step is to find some idea which will answer the need—either through some mechanical, physical or chemical law. Finally comes the actual work of invention where you develop your ideas along the simple, exact lines of Inventive Science, and then protect and market your invention for your greatest profit.

More Inventions Needed Now

I said before that an invention is merely a device for satisfying some need, or improving some other device so that it will work better, faster or cheaper. And, because the world today needs vastly more things than it needed 500 years ago, the demand for inventions is so much more urgent.

It isn't necessary that you must invent something like the steam-engine to make money. Little inventions, such as the crimped hair-pin, the metal bottle-cap, the rubber tip on the pencil have all brought their inventors great fortunes. Gillette, it is reported, has received \$2,500,000 a year for his invention of the Gillette Safety Razor.

To show you what a little invention can bring you in real money, let me tell you the story of two very simple inventions.

The man who invented the Kiddie-Kar (which he produced in his search for a new cheap amusement for his children) is now worth, it is said, more than \$5,000,000. Success Magazine, a few months ago, told the story of a woman who, bothered by a shaky table, fixed up a little wedge-shaped piece of wood. Out of that simple idea she developed an invention which has brought her amazing success.

It doesn't matter what work you do, what your education has been or where you live—you can learn to develop successful inventions. Like the man who invented the Kiddie-Kar you may win a fortune through some device to amuse your children. Even a new kind of kitchen knife to make your wife's work easier can make big money for you. Your daily occupation in the office, in the factory, on the farm; your experiences at home or traveling gives you thousands of ideas every day which can be completed as wonderful inventions. And remember that the world is waiting for more inventions now and will pay big money for even the simplest idea.

You Can Learn Invention At Home

Hitherto the average person has had little



chance of success in invention, because he lacked the necessary instruction in the few essential points of Inventive Science. Now, however, everybody who wants to invent can take advantage of a remarkable new course, devised by fifteen of America's inventors (I am one of them), which shows the right way to practical, successful invention. For the first time, the laws of invention used by Edison, Marconi, Sperry, De Forest and every other great inventor are explained in such simple, easy-to-learn language that everybody can learn to use them.

No longer is it necessary to spend years in useless effort learning the simple secrets which make invention easy. No longer need you waste time on inventions which will never bring you a penny. No longer need you be the victim of unscrupulous persons because you don't know how to protect your rights.

In a fascinating, easy course of 25 "common sense" lessons you are told how to look for ideas for practical money-making inventions, and where they are most likely to be found. You are informed how to develop these ideas quickly and at the least expense. You learn how successful inventors work, the materials they use, where and how they collect their information, the shortcuts they use.

Most important of all you learn how to keep records of your invention to prove priority of origin, how to get patents in the United States and in foreign countries, how to select and deal with patent attorneys, how to protect your patent rights. Finally you are told about that part of Inventive Science which finally makes for success or failure. You are given hints as to the best way to dispose of your patents—how to sell it outright or on royalty, how to organize a company or form a partnership to properly sell your invention so you will get greatest protection and make greatest profits.

All these facts and hundreds of others have been learned by other inventors only after paying a terrific price in long years of unceasing labor, of discouragement and of failure. Now you can get them, without effort, without discouragement or failure, in just a few minutes each day through this absorbingly interesting home-study course.

Everything Explained in New FREE Book

A wonderful book has just been written explaining this course in further detail. If you are genuinely interested, write for it today, and it will be sent to you free. Learn more about this new course in Inventive Science. Find out how you can learn the secrets of successful invention in a remarkably short time, right in your own home. Learn how you can become an inventor, how you can turn a simple little idea into a fortune. It doesn't cost you a penny, so mail the coupon now. The Bureau of Inventive Science has no connections with patent attorneys, manufacturers or promoters. Its only purpose is to give ambitious men and women the facts which help them make invention pay.

BUREAU of INVENTIVE SCIENCE
Dept. 210, Wisner Bldg., Rochester, N. Y.

Bureau of Inventive Science, Dept. 210
Wisner Bldg., Rochester, N. Y.
Please send me your free book, "The Science of Invention."
Name Age
Address
City State



Raymond F. Yates, who with fourteen other famous inventors, now makes it easy for you to learn how to invent in your spare time at home.



It's Fun Learning Cartooning This New Easy Way

IT'S all like a fascinating game—this new home-study method of learning cartooning. You start with the basic principles of cartoon-making. Then you learn the little tricks of originating cartoon-ideas, the secrets of action, expression, and exaggeration. You progress rapidly through serious cartooning, comics, caricaturing, sport and animated cartooning until almost before you realize it you are drawing striking cartoons that **SELL**. Many students of this method have sold enough work while taking their courses to pay for them many times over!

Over \$100 a Week

Learn cartooning this easy way. Never has the demand for cartoons been so great. Today magazines, newspapers, advertisers and movies use them by the thousands. No matter how poorly you draw now, you can quickly qualify for one of the attractive positions in this fast-growing business.

Just think of earning \$3,000 to \$20,000 a year for this work that is play. Successful cartoonists often get \$25 to over \$100 for single cartoons. Then there is the joy of the work itself—the thrill of seeing your own cartoon-ideas in print.

Send for Free Book

Mail coupon today for our handsomely illustrated book, which is crammed full of up-to-date interesting facts about cartooning. It gives you an outline of the whole field of cartooning, describes the opportunities for you in this business, and explains in detail all about this new method which makes cartooning so pleasant to learn. Send for it today!

**WASHINGTON SCHOOL
OF CARTOONING**
Room 2410,
1113-15th St., N. W.
Washington, D. C.



Washington School of Cartooning,
Room 2410, 1113-15th St., N. W., Washington, D. C.
Please send me your Free Book on Cartooning,
and details of your home-study method.

Name.....
(Print Name Plainly)
Address.....
City..... State.....
If under 16 state age.....

Money Making Opportunities

AGENTS AND SALESMEN WANTED

START a profitable and permanent business of your own with our capital. Our salesmen make \$75 to \$125 weekly selling our \$50 all wool tailored to order suits and overcoats for \$31.50 direct to wearer. World's greatest clothes values. Your profit paid in advance. Experience unnecessary. We teach you how to sell and take measures and supply you with the largest and finest tailoring outfit free. 6 x 9 woolen samples. Monarch Tailoring Co., Dept. 52, 100 Fifth Ave., New York.

AGENTS, fastest selling, most useful Pocket Novelty in world, everybody uses; big profits. Bovee Novelty Co., Chicago.

MEN'S Shirts. Easy to sell. Big demand everywhere. Make \$15.00 daily. Undersell stores. Complete line. Exclusive patterns. Free samples. Chicago Shirt Manufacturers, 241 W. Van Buren, Factory 149, Chicago.

EARN \$10 to \$25 a day. Sell beautiful, durable "Novo" Hosiery, Knitted Neckwear and Full-cut Shirts. Direct Mill to Wearer. Complete family line, silks, sport wools. Customer satisfaction defies competition. All or spare time. Investigate. Novo Mills, Dept. F, 3rd & Sedgley, Philadelphia, Pa.

ANOTHER new man is rolling the dollars home. H. E. Ellington, our Utah hustler, with only forty days experience earns \$748.80 in that time. Just turned in a bunch of subscriptions for Alexander Motion Picture Publicity, which net him \$193.20, all sold in one afternoon. Free Sales Training Course helps you to start. We want a few more big men—with an active brain and fightin' blood in their veins. A profession for you—worthy of the name—advertising combined with motion-pictures. Try to get in! Alexander Film Co., 3385 Broadway, Denver, Colo.

AGENTS travel by auto distribute soap samples \$8.75 a day full time. Or we can pay you \$1.25 an hour spare time. Write today for free sample and big offer. Harley Co., Dept. 11, Dayton, Ohio.

SELL Tailoring—the quickest selling, most profitable line in the selling field. Our one-price line shows more than 100 all-wool fabrics for tailored-to-measure suits and overcoats all at one amazing low price. Every order pays you good profit, cash in hand. Tailoring experience not necessary. We furnish handsomest selling outfit and most effective selling helps. Write at once. Goodwear Chicago, Inc., Dept. 608, Chicago.

AGENTS wanted to advertise our goods and distribute free samples to consumers; 90c an hour; write for full particulars. American Products Co., 9847 American Bldg., Cincinnati, Ohio.

FREE Sample "Rain Shield" Wiper. Retail \$1.00—Costs (25c). Sold, Clear and Rainy Days. No Cloth—No Paste—No Attachment. (1) Rub keeps Windshield Clear (48) Hours. Experience Unnecessary. Nulife (1) Corporation, Hartford, Conn.

SALESMEN: We pay larger commissions than any other Brush House in the country to men selling our line of sanitary twisted wire brushes. Sanitary Wire Grip Brush Co., 15-17 Mercer St., New York.

START your own business as our sole agent, selling 100 famous home products. All or spare time. Dr. Blair Laboratories, Dept. 525, Lynchburg, Va.

AGENTS—Steady income. Large manufacturer of handkerchiefs and dress goods, etc., wishes representative in each locality. Factory to consumer. Big profits, honest goods. Credit given. Send for particulars. Freeport Mfg. Co., 24 Main St., Brooklyn, N. Y.

WE start you without a dollar. Soaps, extracts, perfumes, toilet goods. Experience unnecessary. Carnation Co., Dept. 21, St. Louis.

NEW invention; reduces gas bills 50%; big money for agents, write quick. Allied Products, box P. 8., Waterloo, Iowa.

MEN or women to sell Swanley Beauty Clay, Washington Dental Cream. Karmol. Liberal proposition. Big profits. Exclusive territory. Karmol Laboratory, 802 F. N. E., Washington, D. C.

SALESMEN: If you want \$6000 this year, write now. Strong line for retail stores. Nationally advertised; established concern. Liberal weekly advances to producer. George R. Williams, 1920 Euclid, Cleveland, Ohio, Dept. 201.

AGENTS—100% profits. Fast selling novelty for lodge members. Emblematic Belt Co., Ashland, Ohio.

BIG Money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50—make \$1.44. 10 orders daily easy. Write for information and free samples. World Monogram Co., Dept. L, Newark, N. J.

FORDS use kerosene and start instantly. Amazing invention. 200% profit. Territory going. Write Super, 1304-119 Fondulac, Milwaukee, Wis.

SOMETHING Really New in honest merchandise. Every home needs one. Big profits. Sample 25c. Information free. Chas. Whitehead, Cochran, Penna.

AGENTS, both sex. We manufacture and control new household article. Fast seller. Big profit. Exclusive territory. Write now. Connolly 123 Liberty St. New York.

MAKE money silvering mirrors, all kinds plating, knives, spoons, auto headlights. Outfits furnished. Free Booklet. International Laboratories, Dept. 27, 311 Fifth Avenue, New York.

SALESMEN can make \$5.00 a day selling our calendars, pencils, signs, advertising novelties, yardsticks, whistles, etc. Liberal terms. Sells entire year. Fine side line. Local and traveling agencies. Model Calendar Co., Dept. 309, South Bend, Indiana.

EASY, pleasant work for mechanics, shop men, clerks, during spare hours, will add many dollars to their salaries. Also want persons who can give full-time. Big wages assured. Novelty Cutlery Company, 27 Bar Street, Canton, Ohio.

ACCESSORY replacement-part. Most men sell 90% of calls, some earning \$100 weekly. Every auto owner and dealer interested. Bodin Mfg. Co., Allentown, Pennsylvania.

START and operate your own business and acquire financial independence. Openings everywhere. Either men or women. We furnish everything and show you how. Big explanatory book "The Open Door to Fortune" FREE. Ask for it now. National Scientific Laboratories, 17A, Richmond, Va.

**More Money Making Opportunities
on pages 4 to 20**

Have You Been Introduced To These New Words?

Thousands of **NEW** words have come into the language. Are you making them a part of your vocabulary? Can you spell, pronounce, and define them? The "Supreme Authority"—

WEBSTER'S NEW INTERNATIONAL DICTIONARY contains the facts you wish to know!

407,000
Words

6000 Ills.
2700
Pages

Growth

in all activities of modern life may be traced by the **NEW WORDS** in the **NEW INTERNATIONAL**. Here are samples:

Supreme Council	mud gun
junior college	overhead
Czecho-Slovak	soviet
hot pursuit	zircite
fourth dimension	narcism
rotogravure	nacelle
capital ship	megabar
photostat	plasmon
irredenta	psoriasis
agrimotor	precool
Blue Cross	duvetyn
broadcast	Devil Dog
Esthonia	rollmop
altigraph	Riksdag
Flag Day	askari
vitamin	cordoba
paravane	kafirin
Fascista	cyper
realtor	

and thousands of others

Write for a sample page of the New Words, specimen of Regular and India Papers, also booklet "You are the Jury," prices, etc. To those naming Popular Science Mo. we will send free a set of Pocket Maps



**GET
THE
BEST**

G. & C. MERRIAM COMPANY
Springfield, Mass., U. S. A.
Established 1831

Name.....
Address.....
P. S. M.



PLAY PIANO BY EAR

Be a Jazz Music Master

Anyone Who Can Remember a Tune Can Easily and Quickly Learn to Play Popular Jazz or American Rhythm By Ear at a Very Small Cost. The New Niagara Method Makes Piano Playing Wonderfully Simple.

No matter how little you know about music—even though you “have never touched a piano”—if you can just remember a tune, you can quickly learn to *play by ear*. I have perfected an entirely new and simple system. It shows you so many little tricks that it just comes natural to pick out on the piano any piece you can hum. Beginners and even those who could not learn by the old fashioned method, grasp the Niagara idea readily, and follow through the entire course of twenty lessons quickly. Self-instruction—no teacher required. You learn many new styles of bass, syncopation, blues, fill-ins, breaks and trick endings. It's all so easy—so interesting that you'll be amazed.

A Simple Secret to Success

No need to devote years in study to learn piano nowadays. Special talent unnecessary. Every lesson is so easy, so fascinating that you just “can't keep your hands off the piano.” Give it part of your spare time for 90 days and you will be playing and entertaining almost before you realize it. No tiresome scales, no arpeggios to learn—no do-re-mi—no difficult lessons or meaningless exercises. You learn a bass accompaniment that applies to the songs you play. Once learned, you have the secret for all time—your difficulties are over and

You Become Master of the Piano

Even talented musicians are amazed at the rapid progress of Niagara School students and can't understand why this method was not thought of years ago. Naturally, the Niagara Method is fully protected by copyrights and cannot be offered by any other school. A special service department gives each pupil individual attention.

**Learn at
home in
90 days**

Be Popular in Every Crowd

One who can sit down at any time *without notes or music*, reel off the latest jazz and popular song-hits that entertain folks, is always the center of attraction, the life of the party, sought after and invited everywhere. Make yourself the center of attraction—master the piano by spending an hour a day studying the fascinating Niagara Method.

As easily as thousands of others have learned, so you, too, can learn and profit—not only through the pleasure it provides, but also by playing at dances, motion picture houses and other entertainments.

Decide to Begin Now!

Just spend a part of your spare time with a few easy, fascinating lessons and see how quickly you “catch on” and learn to play. You will be amazed, whether you are a beginner or an advanced student.

Write for interesting, illustrated booklet, “The Niagara Secret”—it describes this wonderful new method of playing piano by ear. *This booklet sent FREE.*

Ronald G. Wright, Director, NIAGARA SCHOOL OF MUSIC, Niagara Falls, N.Y.



**This Book
FREE**

CLIP THIS COUPON NOW

Niagara School of Music, Dept. 587, Niagara Falls, N. Y.
Without obligation mail me your booklet, “The Niagara Secret.”

Name.....
St. and No. or R. F. D.
Town..... State.....
Age..... Ever take piano lessons?..... How many?.....

Copy this Sketch!



I AM anxious to find men with a desire to become draftsmen. With business picking up everywhere many thousands of draftsmen will be needed at salaries up to \$3000 to \$3600 per year.

In asking you to copy this sketch I believe I will be able to tell from the sketch you send in what kind of an opportunity you will have in this great profession.

There are no conditions requiring you to buy anything. You are under no obligations in sending in your sketch.

FREE!

\$80 Drafting Course

To every student enrolling now I give an opportunity of getting an \$80 drafting course absolutely without cost to him. So send in your sketch today and learn all about this offer.

For Sending Copy of Drawing



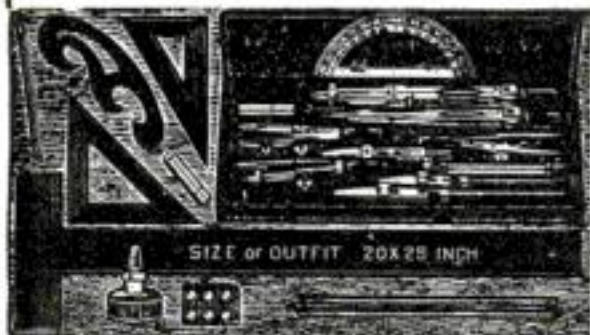
Draftsman Pocket Rule FREE

To every person of 16 years or older sending a sketch I am going to mail free and prepaid the Draftsman's Ivory Pocket Rule shown here. This will come to you entirely with my compliments. With it I will send you a 6 x 9 book on "Successful Draftsmanship."

Salaries up to \$250 and \$300 a Month

Position paying up to \$250 and \$300 per month, which ought to be filled by skilled draftsmen are vacant everywhere. There are in every part of this country ambitious men, who with practical training and personal assistance, will be qualified to fill these positions. Mr. Dobe guarantees to train you UNTIL placed in a permanent position at a salary up to \$250 and \$300 per month.

FREE \$25 DRAFTING OUTFIT



Mr. Dobe will give you this entire outfit free if you enroll at once. Don't delay. Send for full information TODAY!

Mail Your Drawing At Once—

and Get Ivory Pocket Ruler Absolutely Free! Ambitious men, interested in drafting, hurry! Don't wait! Send in your sketch or request for FREE Book and Ivory Pocket Rule Address:

Chief Draftsman
Engineers Equipment Co.
1951 Lawrence Ave., Div. 13-67 Chicago, Ill.

Money Making Opportunities

HELP WANTED

HE a detective. Excellent opportunity to earn big money, travel, thousands of dollars offered in rewards. Established 1909. Particulars free. Write to C. T. Ludwig 424 Westover Bldg., Kansas City, Mo.

SILVERING Mirrors, French plate. Easily learned; immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Blann Sign System, East Bethune Avenue, Detroit, Michigan.

MEN—Age 17 to 40. Experience unnecessary. Travel, make secret investigations, reports. Salaries, expense. American Foreign Detective Agency, 321, Ft. Louis.

GOVERNMENT positions, \$1400-\$2300 yearly. Many openings. Thirty-six page information booklet free. Chicago Civil Service College, B-70, Keener Building, Chicago.

MAKE money in spare time mailing letters. Rare opportunity now. Men, send addressed envelope for special terms. Normande H, 147 West 23d St., New York.

WANTED—Ambitious men to work at home. New business, local or mail order. Ordinary men make \$15-\$25 day. You can too. Interesting particulars; write Kraft, Box 896-P8, San Francisco, California.

DETECTIVES earn big money. Excellent opportunity. Travel, fascinating work. Experience unnecessary. Particulars free. Write, American Detective System, 1968 Broadway, New York.

STOP daily grind. Silver mirrors, headlights, tableware. Replate stoves, jewelry, brass beds. Dependable plans free. Clarence Sprinkle, Dept. 95, Marion, Indiana.

\$133-\$192 MONTH. Railway Mail Clerks wanted. Steady work. Sample examination questions free. Franklin Institute, Dept. B41, Rochester, N. Y.

FIREMEN, brakemen, baggage men, sleeping car, train porters (colored). \$140-\$200. Experience unnecessary. 838 Railway Bureau, E. St. Louis, Ill.

\$80-\$200 WEEK. Genuine Gold Letters for store windows easily applied. Liberal offer to general agents. Metallic Letter Co., 431B N. Clark, Chicago.

RAILWAY Postal Clerks—Start \$133 month. Railroad pass; expenses paid; questions free. Columbus Institute, N-2, Columbus, Ohio.

SECURE Employment, South America or Pacific Coast by Correspondence. 500 addresses \$1. Information Bureau, Chamber Commerce Bldg., Portland, Oregon.

EARN \$110 to \$250 monthly, expenses paid, as Railway Traffic Inspector. Position guaranteed after completion of 3 months' home study course or money refunded. Excellent opportunities. Write for Free Booklet, CM-13 Stand. Business Training Inst., Buffalo, N. Y.

BUSINESS OPPORTUNITIES

YOU can have a business profession of your own and earn big money in service fees. A New system of foot correction; readily learned by anyone at home in a few weeks. Easy terms for training, openings everywhere with all the trade you can attend to. No capital required or goods to buy, no agency or soliciting. Address Stephenson Laboratory, 15 Back Bay, Boston, Massachusetts.

USED correspondence courses sold, rented, and exchanged. List free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

MAKE money with your camera. E. Lancaster, Box 967, Los Angeles.

PATENTS procured. Trade marks registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Building, Washington, D. C., or 2276-Z Woolworth Bldg., New York.

INCH Display Advertisement 161 Magazines Thrice \$15. Year \$50. Wood's Popular Services, Atlantic City.

UNLIMITED possibilities, making metal toys at home. No experience required. Particulars free. New Specialty Co., 448 E. 79th St., New York.

YOUR Opportunity. Start a Magazine and Mail Order Business. Sample Magazine 10c. Plan Free. H. J. Teeple, Decatur, Indiana.

LEARN the collection business. Good income; quick results. Interesting booklet, "Skillful Collecting," free. National Collector's Association, Science Building, Newark, Ohio.

STATE manufacturing rights for sale. Valuable patent. Fortune for you. Machinery unnecessary. Dr. Schmidt, Blanton, Florida.

STOP plodding! Be successful. Operate a tire repair shop. Make big profits in any locality. We teach you and furnish complete equipments, \$100 up. Book of Opportunity free. Haywood's, 1306 South Oakley Avenue, Chicago.

"MONTHLY Schemer." Alliance, Ohio, prints big profit schemes; one subscriber making \$25,000 from three; another \$10,000 from one. Try your luck. Year, \$1; 3 months, 25c.

ARTIFICIAL Marble, sanitary flooring instruction, ornamental casting, concrete plaster, papier-mache decorations, garden furniture, statuary. Rubber-moulds. Electrometallurgy, particulars and 200 illustrations free. Chris Mahler, Huntington, N. Y.

CHEMICAL expert furnishes six manufacturing formulas with complete working directions. 50c coin. Crane Mfg. Co., Box 16, Washington, D. C.

BANKNOTES of Russia, Poland, Austria and Germany in denominations up to 1,000,000. Write for information on same and how to start your own business. George Grigoleit, 20 E. Jackson, Chicago.

WE Start you in business, furnishing everything; men and women, \$30.00 to \$100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime; booklet free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

I MADE \$30 a week home. French breadmaking. 15 years' experience; free booklet tells. Ashbrook, E. 67, Marengo, Ohio.

ESTABLISH a cash business—No canvassing. Capital \$100 up. Information Dept. R, Paul Kaye, 149 Broadway, New York.

PUBLISH your own magazine. Everything supplied. Sample and instructions; quarter. Lebeuf, Bangor, N. Y.

MONEY making propositions. Particulars free. Lemke, Box 572-A, Cincinnati, Ohio.

MAIL Order News, 500 Fifth Avenue, New York; Explains Mail Order Business. 25c Copy.

FREE Instructive Book. Start your own little Mail Order business. Home employment evenings. Also secure Agents to sell for you. We tell you how. Also furnish Beginner's Outfit, circulars, samples, specialties. Book sent free. Pier, 271-A, 74 Cortland Street, New York.

More Money Making Opportunities
on pages 4 to 18

A RAISE IN SALARY

In Two Weeks

BY

Raymond A. McCue



BE A RAILWAY TRAFFIC INSPECTOR

SEVEN months ago I sat by the old farm fireside, discouraged, with no encouraged chance for a prosperous, active future.

Humbly inserted in a corner of a little farm magazine was a Railway Traffic Inspection ad. Through curiosity I invested a postage stamp and inquired.

When I read what the S. B. T. I. had done for others through their training, I made up my mind to let them do the same for me. They have lived up to their agreement.

When I commenced taking this course all I was good for was to pitch hay and milk cows. I was not contented with this life and every day was a day of drudgery.

A Dream Come True

A dream of a future has come true inside of a term of a few short months. I am now a full-fledged Traffic Inspector on a large electrical system in one of the largest cities of the United States—thanks to the S. B. T. I.

This position pays more at the beginning than the Institute guaranteed me. I am told by the manager that my work is satisfactory and that he will give me a raise in salary in two weeks if it continues to be so.

My advice to the fellow who is on the fence, scratching his head, is to do as I wisely did. Enroll with the Standard Business Training Institute and let them build a future for you.

I shall always be pleased to recommend this school to anyone.

EARN UP TO \$250 A MONTH EXPENSES PAID

Pleasant, healthful, outdoor work; excellent chances for advancement thru contact with railway executives. Travel or remain near home.

Prepare at home in spare time. Position GUARANTEED paying at least \$110 a month and expenses or tuition refunded.

YOU TAKE NO RISK

Send coupon at once for details of this fascinating, uncrowded profession. If we don't get you a position, the training costs you nothing. Act now!

Standard Business Training Institute
Buffalo, N. Y.



Standard Business Training Institute
Buffalo, N. Y.

Send me, entirely free, Booklet No. D-64, giving full particulars about course in Railway Traffic Inspection.

Name

Street

City.....



Sensational Clearance Sale \$2.98 for All 6 BIG LAW BOOKS

THE biggest book bargain of your life! Act quick and you can have this wonderful Law Library at a saving of two-thirds of the former price. Think of it—an encyclopedia of commercial law, written in a fascinating, interesting style—now yours for only 50 cents a volume.

Handsome Law Library Reduced From \$10.00

The entire range of commercial law is covered in these six splendid, full size volumes. There are chapters on ownership, deeds, landlord and tenant, corporations, insurance, marriage, divorce, bankruptcy, domestic relations between employer and employee. Every conceivable phase of commercial law is covered in these 6 books.

1300 Pages Full of Valuable Legal Advice

With these wonderful books in your library you are always prepared for any legal emergency. You are sure of your legal rights. You need never make any costly, embarrassing mistakes. No more fees to lawyers! In a single instance these books can save many, many times the small first cost. At home or in your office they prove valuable friends.

Send No Money

Just write a letter or postcard—without a penny in advance. The six volumes will be sent for 5 days' examination. Deposit with postman only \$2.98 in full payment. Within 5 days you can return the books and get your money back. But we're sure that once you examine and read these handsome volumes you'll never want to part with them. Mail the coupon NOW before the edition is gone.

NELSON DOUBLEDAY, Inc.
Dept. H-2510, Garden City, New York

Everyone Admires the Good Dancer

Everyone admires the ease of manner, the self-confidence and poise, the perfect step and grace which are always characteristic of one who dances well. You can quickly learn to be the best dancer in your set through Arthur Murray's wonderful new method of diagrams and printed instructions. Even if you don't know one step from another through this method you can quickly and easily master any dance right in your own home, without either music or partner. Lessons are so simple that even a child can learn from them. After you have this Murray foundation to your dancing you can quickly "catch-on" to any dance you see, after you have been shown a few of the new steps. Your success is guaranteed!



5 Dancing Lessons Free

To prove that you can quickly and easily learn to dance through Arthur Murray's method he will send you FREE, in plain cover, a lesson in Fox Trot, Secret of Leading, How to Gain Confidence, How to Follow, How to Avoid Embarrassing Mistakes. To pay cost of printing and mailing enclose 25c.

More than 90,000 people have learned to dance this new way and there is no reason why you should not learn just as easily and quickly as they did. Send for the FIVE FREE LESSONS today and be a good dancer soon. This offer may soon be withdrawn.

ARTHUR MURRAY
Studio 837, 290 Broadway, New York

Become a Dancing Teacher Earn \$5000 to \$10,000 per year. Write for booklet 37, to Arthur Murray at above address.

Send for FREE Trial Lesson in DRAFTING

Just sign and mail the coupon and we will send this Trial Lesson which will show you how well prepared you are to take up Drafting. While other schools ask you to enroll and pay a fee before you receive instruction, we send you this free lesson first. Before you pay—before you even decide about enrolling—you can test your ability and also learn about the Chicago Tech. Method of teaching Drafting by mail. Send today—no money, only the coupon.

Big Salaries for Experts

Everywhere there is a call for capable Draftsmen—men who can take hold of important work and see it through. Men of this kind are always in demand at high salaries by railroads, manufacturers, architects, contractors, electrical works and other big industries. Don't waste time in a small job with no future when such an opportunity as this is offered.

Chicago Tech. Will Train You By Mail

The Chicago Tech. Home Study Course will make you expert in any branch of Drafting in your spare time at home. Just give a few hours weekly and you prepare for advancement and a high salary.

Soon after enrolling salary increased \$225 a month.

A. S. ROSS

Chicago Tech. training increased my salary 300%.

R. L. CARY

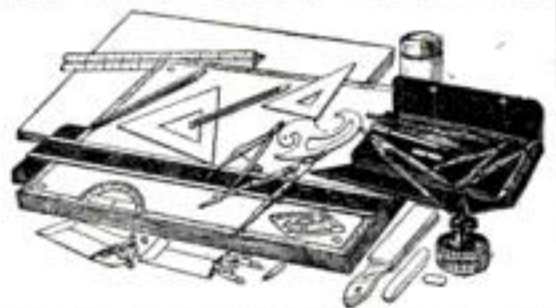
Was laborer. Now manager because of Chicago Tech. training. J. A. DaCOSTA

TO EMPLOYERS Chicago Tech. men are practical. Write to us when you need Draftsmen.

Practical Instruction

Chicago Tech. instructors are practical engineers. They give you the kind of training that commands the highest pay. No time put in on useless theories. Every lesson deals with actual problems and you are constantly under the personal direction of men who give you the kind of knowledge that counts for most. The success of Chicago Tech. men proves that this course is the short cut to big pay in Draftsmanship.

FREE Drawing Outfit



Students enrolled with Chicago Tech. for home study in Drafting receive this complete Drawing Outfit with no extra charge (or credit on fees, if they have outfits). A regular full size outfit—same as used by practical draftsmen and engineers.

Send Coupon

* Mail the coupon and get the Free Trial Lesson—also catalogs and full information about the Chicago Tech. Method of teaching Drafting by mail. No cost to you—no promise or obligation. Send today.

Chicago Technical College, 1031 Chicago Tech. Bldg., Chicago, Ill.

Without cost or obligation on me please send instructive matter about opportunities in line I have marked with "X."

- () Drafting. (The Big Salary Course) No experience necessary. Free Lesson sent now.
() Building Trade Course For men in the building lines.

Name.....

Address.....

Post Office..... State.....

BE AN ARTIST

ARTISTS EARN BIG MONEY

Turn your talent into money. We can teach you drawing in your home during spare time. Well-trained artists earn from \$40 to \$200 a week. Thousands of publishers and advertisers need the work of good artists. The MODERN METHOD is an easy way to learn to draw original pictures. Send 3 stamps today for full particulars showing opportunities for you. State your age.

MODERN INSTITUTE OF ART
7 East 42nd Street Dept. 40 New York City

WANTED

Railway Postal Clerks
\$1600 to \$2300 Year
MEN—BOYS 18 OR OVER

SHOULD WRITE IMMEDIATELY
Steady work. No layoffs. Paid Vacations
Travel—See the country on Government time
Common education sufficient
Send Coupon today—SURE

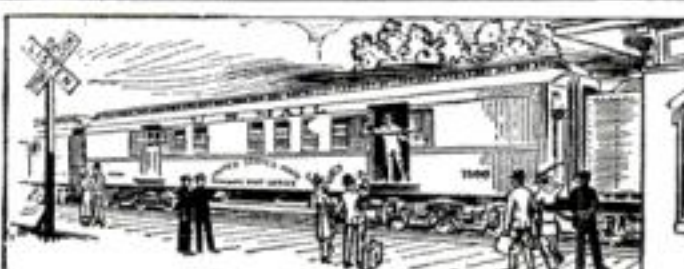
A FILE

Stop Forgetting

Make Your Mind an Index from which you select facts, figures, names, faces. Develop concentration, self-control; overcome bashfulness, forgetfulness. Write today for FREE memory and concentration test and illustrated booklet, "How to Remember."

PROF. HENRY DICKSON
Dept. 929 Evanston, Ill.

NOT A FILE



FRANKLIN INSTITUTE, Dept. A281, Rochester, N. Y.

Write: Send me without charge. (1) Sample Railway Postal Clerk Examination questions; (2) List of Government jobs obtainable; (3) Tell me how I can get a position.

Name.....

Address.....

Only 50 days Between You and Big Money in AUTOMOTIVE ELECTRICITY



Four Times His Former Salary
"I was making \$40 a week as Head Bookkeeper when I took up your training. Last week I made \$175, and hardly a week passes in which I don't make at least \$100. No labor either. I locate the trouble and the mechanics do the work."
—HENRY L. LUDLOW, Tenn."

**Come to Chicago
or Train at Home
for this New Field
that Covers 78% of
AUTOMOBILE
TROUBLES**



Makes \$1000 a Month
"I trained with you 7 weeks. Then I started right to work with a big garage. Averaged about \$150 a week. After 8 weeks I opened my own shop. Find it easy to get any price I choose to charge. Clearing over \$1000 a month."
—W. C. ELLERD, Neb."

YOU'D probably be willing to take a four year college course if you could earn \$132.00 a week when through. But you don't have to. **FOR YOU CAN BE READY IN FIFTY DAYS** to earn that much and more, just like any number of my former students are doing. Get my book that gives the facts and figures.

Big Jobs Open

This fascinating new profession is clamoring for men. Garage and Repair Shop Owners can get all the ordinary mechanics they need. Mechanics can learn in a shop, but Auto-Electrical Experts are study-trained. That's why shops can't get the man who knows automobile electricity. And yet they've got to have him. Auto-owners will no longer pay for 10 hours' service while an ordinary mechanic fiddles around trying to find what is wrong. When you consider that 78% of all automobile troubles are electrical you'll realize why the car owners are combing the markets for experts. My free book will give you some surprising facts.

No Experience

Best of all, you can get in this big pay profession in 50 days—without knowing about electricity or automobiles beforehand. If you can read and write, you can succeed. We teach you everything in a practical, brass tacks way, which my book explains fully.

Amazing New Way to Train

When the government needed Auto-Electrical Experts for the war there was no

AMBU ENGINEERING INSTITUTE
Dept. 410, 2632 Prairie Ave., Chicago

Please send me FREE book and complete information about the big pay, uncrowded field of Automotive Electricity. Explain to me your remarkable short time offer.

☐ Home Study Course.
☐ Resident Course at Chicago.

Name.....
Address.....
City.....
State.....



QUALIFY For One of These Big Pay Jobs

\$132 a week is not out of reach for Automotive Electricians. Fascinating work. No heavy lifting. No grease. Work is 90% headwork or directing and 10% handwork. Automotive Electricity is a Profession, not a Trade. It offers every man the road to quick success.

time to waste. Men had to be trained 100% right and sent out almost over night. The man who invented the 50-day method was the man to whom Uncle Sam went for help. Results were amazing. Never before had such a thing been accomplished by anyone. A complete, practical, thorough training in 50 days. So remarkable that after the war, and at a great cost, it was made available to Ambu students only. Ambu has even improved on the original plan by **not admitting more than 20 men to a class. No other school does this** and the bigger the class the less you learn.

When my graduates are grabbed up at big salaries; when men like Ludlow jump from a \$40 a week bookkeeping job into an income of \$175 a week as Auto-motive Electrical Experts; when fellows who want to be their own boss, like Ellerd, clean up \$1000 a month; everybody simply HAS to agree that Ambu Training can't be beat. Get my book and see the proof.

Get Out of the Grease

I know what a demand there is for my graduates. I know what remarkable earnings they are making. I know how employers are glad to get their services. I have hundreds of letters that show how Ambu graduates "make good." I'll send you copies of them; tell you to write these former pupils; let them tell you what a fascinating, easy profession it is. In my free book I show you how you can get paid big for headwork, not handwork; how you keep out of the grease, lifting, labor, etc., which the ordinary mechanic has to do.

Get FREE Book

Everything is explained in a remarkable eye-opening book that will be a revelation to you. It shows how my graduates are equally expert whether they come to classes here in Chicago or LEARN IN SPARE TIME AT HOME.

Get it at once. It is free. If you act quick you'll also be able to take advantage of a most unusual short-time offer I am making. Mail coupon today.

C. J. BUCKWALTER, Pres.

AMBU ENGINEERING INSTITUTE
Dept. 410, 2632 Prairie Avenue
CHICAGO

\$25.00 in Prizes

See top of page four in front of book for details

What Shall I Be?

DECIDE THIS QUESTION ONCE FOR ALL!
WEALTH—POWER—HAPPINESS—all the worth-while things of life—depend upon the right choice of occupation. Expert Vocational Guidance, of the right kind, now available to everybody. Write for free information today.
BUREAU OF VOCATIONAL RESEARCH
296 Broadway, Dept. 10, New York City

**MAKE MONEY
AT HOME**

15 to 50 Dollars a Week for Your Spare Time. No Canvassing. Experience Unnecessary. Write today for Illustrated Booklet and Free Working Outfit.
UNITED SHOW CARD STUDIO, 507 Dinan Bldg., Detroit, Mich.

FORD RUNS 57 MILES ON GALLON OF GASOLINE

A new automatic and self-regulating device has been invented by John A. Stransky, 291 Fourth St., Pukwana, South Dakota, with which automobiles have made from 40 to 57 miles on a gallon of gasoline. It removes all carbon and prevents spark plug trouble and overheating. It can be installed by anyone in five minutes. Mr. Stransky wants agents and is willing to send a sample at his own risk. Write him today.—Adv.

Wrestling Book FREE

Learn to be an expert wrestler. Know scientific wrestling, self-defense, and jujitsu. Develop a splendid physique, and have perfect health. Join this popular school and learn by mail. The famous world's champions—the marvelous
Frank Gotch and Farmer Burns offer you a wonderful opportunity. Wrestling is easily and quickly learned at home by mail. Men and boys write now for splendid free book. Learn all the science and tricks. Be able to handle big men with ease. Accept this wonderful offer NOW. Send for free book today, stating your age.
Farmer School of Wrestling 1787 Railway Bldg., Omaha, Neb.

**WANTED—
for murder!**

\$1,000 REWARD!

IN a dirty, forlorn shack by the river's edge they found the mutilated body of Genevieve Martin. Her pretty face was swollen and distorted. Marks on the slender throat showed that she had been brutally choked to death. Who had committed this ghastly crime? No one had seen the girl and her assailant enter the cottage, no one had seen the murderer depart. How could he be brought to justice?

Crimes like this have been solved—are being solved every day by Finger Print Experts. Every day we read in the papers of their exploits, hear of the mysteries they solve, the criminal they identify, the rewards they win. Finger Print Experts are always in the thick of the excitement, the heroes of the hour.

Not Experienced Detectives—Just Ordinary Men

Within the past few years, scores of men—men with no police experience, men with just ordinary grade school educations—have become finger print experts. You can become a finger print expert, too. Can you imagine a more fascinating line of work than this? More trained men are needed. Here's your real opportunity.

Learn the Secrets of Identification

More and more the detection of crime resolves itself into a problem of identification. You can learn the methods of the famous identification experts. You can learn the science of Finger Print Identification—right at home in your spare time.

Free Course in Secret Service

For a limited time, we are making a special offer of a **Professional Finger Print Outfit** absolutely free and FREE course in secret service intelligence. Mastery of these kindred professions will open a brilliant career for you.

This coupon will bring you FREE book and details of this great offer. Don't wait until the offer has expired. Fill in the coupon now. Mail it today.

University of Applied Science
Dept. 13-67, 1920 Sunnyside Ave., Chicago, Ill.

UNIVERSITY OF APPLIED SCIENCE
Dept. 13-67, 1920 Sunnyside Ave., Chicago, Ill.
Gentlemen:—Without any obligation whatever, send me your new, fully illustrated FREE book on Finger Prints and your offer of a FREE course in Secret Service Intelligence and the Free Professional Finger Print Outfit.

Name.....
Address.....
City & State..... Age.....

If New Hair Doesn't Grow After Using My Method —I Don't Want a Penny!

I mean just exactly what I say! I don't care how thin your hair may be—I don't care how many treatments you may have taken without results. If my new discovery won't restore your hair, I don't want to keep a cent of your money! Furthermore I'll send you the proof of what I have done for others entirely FREE! Just mail the coupon below.

By ALOIS MERKE

Founder of Famous Merke Institute, Fifth Ave., New York

AFTER 17 years' experience in treating baldness—which included long years of experimentation in Heidelberg, Paris, Berlin, Geneva, Cairo and other centers of scientific research—I have discovered a startling new way to promote hair growth.

At the Merke Institute, Fifth Avenue, New York—which I founded—I have treated scores of prominent stage and social celebrities. People are coming to me from all parts of the country to gain the benefits of my discovery. Many pay as high as \$500 for the results I have brought them.

Yet now, through a series of ingenious inventions, I have made it possible for every one to avail themselves of my discovery—right in their own homes, and at a cost of only a few cents a day!

My Unusual Guarantee

I know you are skeptical. I know that you have tried perhaps dozens of different remedies and treatments without results. I know that you have wasted time and money on treatments which by their very nature could NEVER restore your hair. All right. Perhaps my treatment cannot help you, either. I don't know. But I do know that it has banished falling hair and dandruff for hundreds of others—often with the first few treatments. I do know that it has already given thick, luxuriant hair to people who long ago had despaired of regaining their hair. And I am so downright positive that it will do the same for you that I am entirely willing to let you try it at my risk—and if it fails to restore your hair, then I'll instantly—and gladly—mail you a check, refunding every cent you have paid me. In other words, I absolutely GUARANTEE to grow new hair on your head—and if I fail, then the test is free.

Entirely New Method

What is my method? It is entirely new. It is entirely different from anything you ever heard of. No massaging—no singeing—no "mange" cures—no unnecessary fuss or bother of any kind. Yet results are usually noticeable even after the very first few treatments.

Many people have the idea that when the hair falls out and no new hair appears, that the hair roots are always dead.

I have disproved this. For I have found in many cases which have come under my observation that the hair roots were NOT dead, but merely dormant! Through undernourishment, dandruff and other causes, these starving, shrunken roots had literally gone into a state of "suspended animation." Yet even if the scalp is completely bare, it is now possible in the majority of cases to awaken these dormant roots, and stimulate an entirely new growth of healthy hair! I KNOW that to be true—because I do it every day.

Ordinary measures failed to grow hair because they did not penetrate to these dormant roots. To make a tree grow, you would not think of rubbing "growing fluid" on the bark.



Instead, you would get right to the roots. And so it is with the hair.

In all the world there is only one method I know about of penetrating direct to the roots and getting nourishment to them. And this method is embodied in the treatment that I now offer you on my positive guarantee of satisfactory results, or the trial costs you nothing. The treatment can be used in any home in which there is electricity.

Already hundreds of men and women who only recently were bald or troubled with thin falling hair, have through this method acquired hair so thick that it is the envy and admiration of their friends. As for dandruff and similar scalp disorders, these usually disappear after the first few applications.

Remember—I do not ask you to risk "one penny" in trying this treatment. I am perfectly willing to let you try it on my absolute GUARANTEE—and if after

30 days you are not more than delighted with the growth of hair produced, then I'll gladly return every cent you have paid me. I don't want your money unless I grow hair on your head.

Free Booklet Explains Treatment

If you will merely fill in and mail the coupon below I will gladly send you—without cost or obligation—an interesting 32-page booklet, describing my treatment in detail.

This booklet contains much helpful information on the care of the hair—and in addition shows by actual photographs what my treatment is doing for others.

No matter how bald you are—no matter if you are completely bald, this booklet will prove of deepest interest to you. So mail the coupon now—and it will be sent you by return mail.

ALLIED MERKE INSTITUTES, Inc.

Dept. 1710

512 Fifth Ave., New York City.

Actual Results

(Dozens of letters like the following are received every day by the Merke Institute.)

"In the short time I have used your treatment I have gained remarkable results. Dandruff has disappeared entirely. My scalp is now all full of fine new hair. Would not part with my treatment for 10 times its cost." A. W. B.

"The top of my head is now almost covered with new hair about one-half inch long. I have been trying five years, but could never find anything to make my hair grow until your treatment." T. C.

"Ten years ago my hair started falling. I used hair tonics constantly, but four years ago I displayed a perfect full moon. I tried everything—but without results. Today, however, thanks to your treatment, I am pleased to inform you that I have quite a new crop of hair one inch long. My friends are astonished at the result." F. H. B.

ALLIED MERKE INSTITUTES, Inc., Dept. 1710
512 Fifth Avenue, New York.

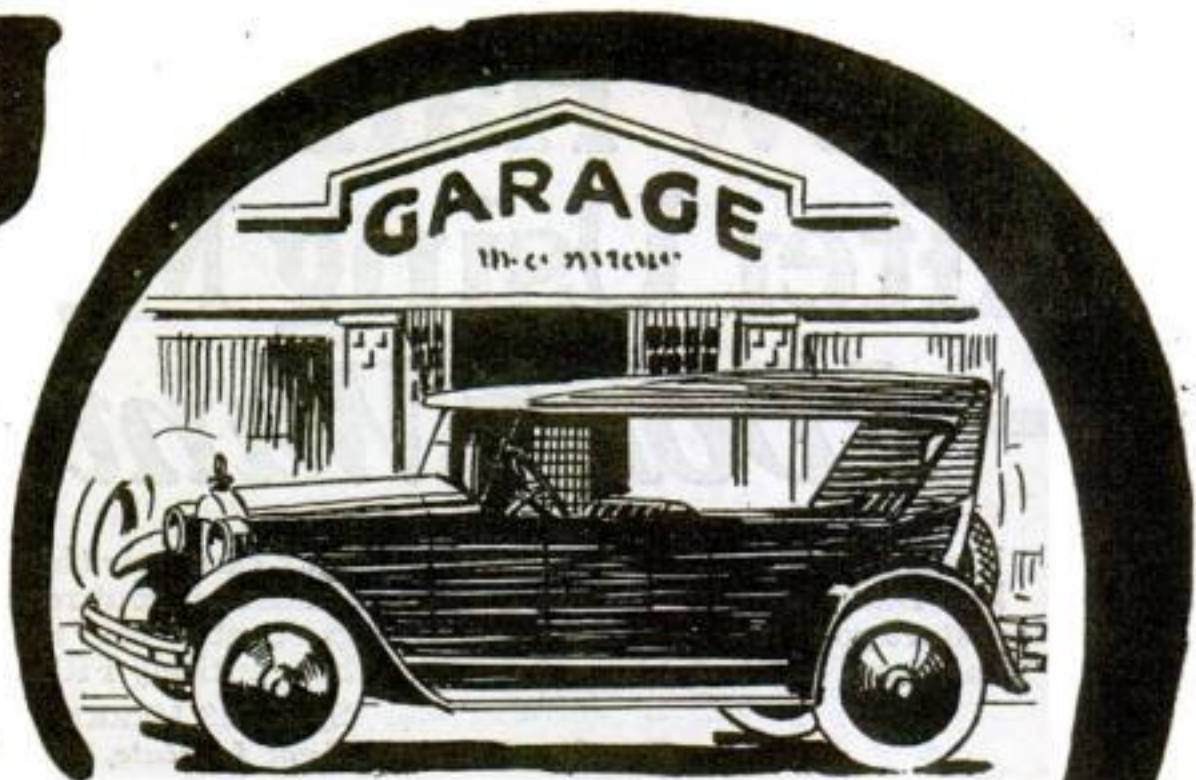
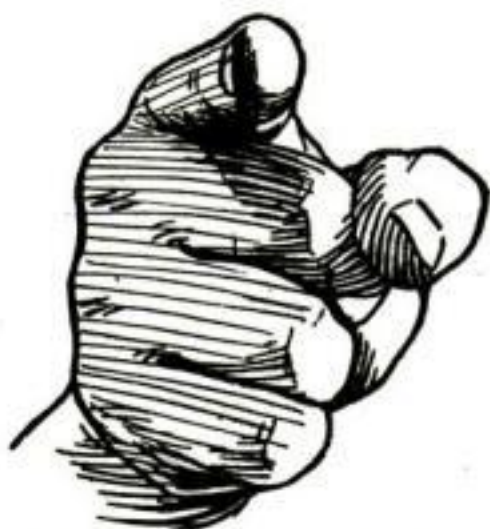
Please send me, without cost or obligation on my part, a copy of the new booklet describing in detail the Merke Institute Home Treatment.

Name.....

Address.....

City..... State.....

YOU



WHAT ABOUT AN AUTOMOTIVE JOB *Paying \$50 to \$125 per Week*

You can have one after a few short weeks of mighty interesting training at Greer College. Never before in automobile history has there been such a demand for expert automobile workmen. Hundreds of requests for Greer Graduates are now in our files, waiting to be filled. We want more ambitious students to qualify for the big money jobs.

We want YOU—AT ONCE.

Paying Jobs Furnished While You Learn

We can place you in positions paying up to \$30.00 per week while you learn. With this help you can get through easily. In 8 short weeks you can graduate as a Certified Automotive Engineer with a lifetime of big earnings ahead of you.

Complete Greer Course includes Machine Shop Practice, Shop Management, Selling, Truck, Tractor and Automobile Repairing in the big Greer shops, Lighting, Starting, Ignition, Tire Repairing, Storage Batteries,

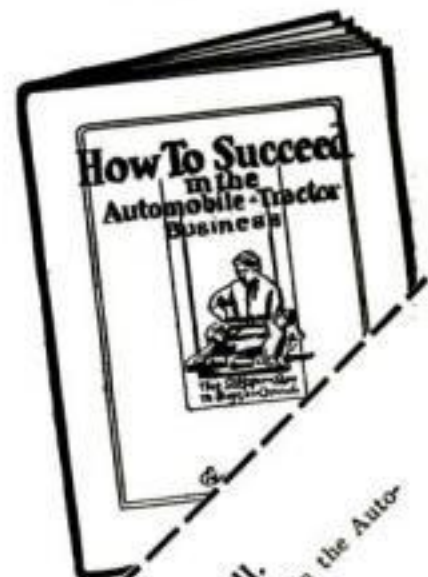
Driving—Everything you need to qualify you for high paid positions anywhere.

Day and Evening Classes

Your work need not interfere with your Greer studies. Classes are suited to your convenience.

Write, call or 'phone for your earn-while-you-learn job—and send the coupon for FREE BIG Booklet "How to Succeed in the Automobile Business," all about automobile and garage work. Act now, while there is still room for you.

Mail
Coupon
for this
**FREE
BOOK**
Now!



GREER

COLLEGE

of Automotive Engineering

2040 S. Wabash Avenue,

Chicago, Ill.

ERWIN GREER, President
2040 S. Wabash Avenue, Chicago, Ill.
Send me your Free Book, "How to Succeed in the Automobile Business," and Special Tuition Offer.
Name
Address

THEY SAY—

Brief Bits of Timely Comment on the Sciences of the Hour

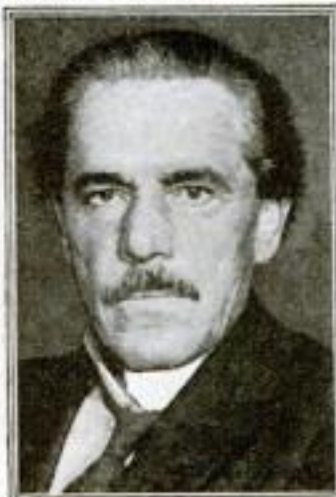


PROF. A. M. LOW, the "Edison of England," whose wonderful invention for photographing noise has been used successfully in the London underground railways. He is shown above watching the motor races at Brooklands, Eng., where the exhaust noises of the competing cars were measured by his device:

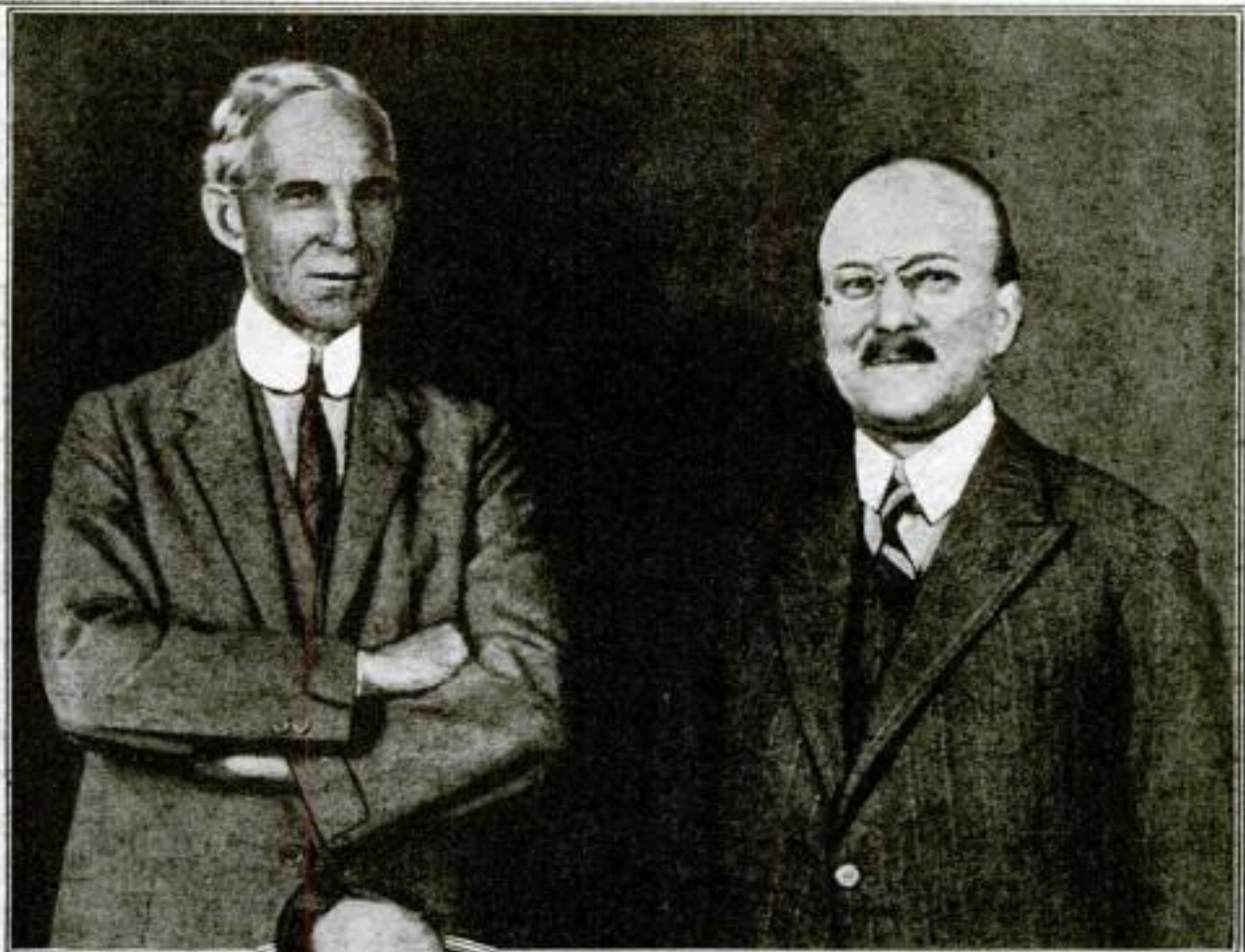
"European scientists are on the eve of announcing one of the greatest discoveries of the age—flexible glass. I am confident that their experiments will prove successful within two years. Then we may possibly see the folding window-pane, the collapsible electric-light bulb and unbreakable dishes."

DR. ALES HRDLICKA, of the National Museum in Washington, D. C., and head of the American School for Prehistoric Studies in Europe, who is now directing a party of scientists visiting western Europe in search of prehistoric man:

"It seems to be becoming more and more likely that man himself originated in western Europe. Archeological specimens representing man's history from the earliest part of the Ice Age and possibly before have been recovered in great numbers from this field. The museums of Paris, Brussels, London, and Prague are filled with them. But vast deposits are still unexplored."



Dr. Ales Hrdlicka



ANDRÉ CITROËN, automobile manufacturer, known as "the Henry Ford of France" (at right), photographed with Henry Ford during the Frenchman's recent visit to America:

"I think there is plenty of room for more cars in America. Americans like something new and they like it quick and good. I intend to build a factory in America soon and expect to be manufacturing cars there by February. I have found that American engineers can give me great help in improving the rate of output and solving problems to which French helpers are unused. I have picked in America some skilled men, the like of which I had not found before, and they are to help me in my French plants. I expect by their aid to triple the output of my factory."



DR. E. F. PHILLIPS, head of the bee station of the United States Department of Agriculture at Somerset, Md., who has discovered many interesting new facts about bees:

"The average bee, which weighs about 75 milligrams, will produce about seven times its weight in honey during its lifetime. Yet bees sometimes are lazy. Contrary to popular belief, the bee's sting is essentially for protection against intruding stranger bees."

DEAN ALBERT C. EYCLESHYMER, of the College of Medicine, University of Illinois:

"The search for the 'elixir of life' is about at an end; yet in this chase after eternal youth, medical science has succeeded in prolonging life 16 years. Regularity, plain diet, and exercise are the basis of longevity. We should all live to be 100 years old."



Sir Joseph Thomson

SIR JOSEPH THOMSON, British scientist and discoverer of the electron, who recently witnessed the progress of American engineers with his theory of electrons, and who now predicts that science will discover a new kind of water:

"The discovery of a substance that would break down one of the hydrogen electrons in the water molecule would make possible another kind of water. There is no reason why, with a strong enough agent, another kind of water could not be discovered."



"Music and Beauty make life pleasant"
Yang Chu.

The New GREBE Broadcast Receiver

delights both ear and eye—

Doctor Mu.

REGENERATION and Tuned Radio Frequency Amplification find their first successful combination in this Receiver. The 20-foot silk-covered wire, readily concealed behind the picture moulding, is the only antenna required.

The attractively finished walnut cabinet has compartments for all necessary batteries.

Write for "GREBE Radio in the Well-Appointed Home"



GREBE RADIO

Licensed under
Armstrong L. S.
Pat. No. 1113149

A. H. GREBE & COMPANY, Inc.
Richmond Hill, N.Y.
Western Branch, 451 East 3rd St., Los Angeles, Cal.



Type CR-12



What Static Sparks Cost Us

Science Teaches Motorists How to Protect Themselves Against a Danger in Fuel that Is More Deadly than Dynamite

By Raymond J. Brown

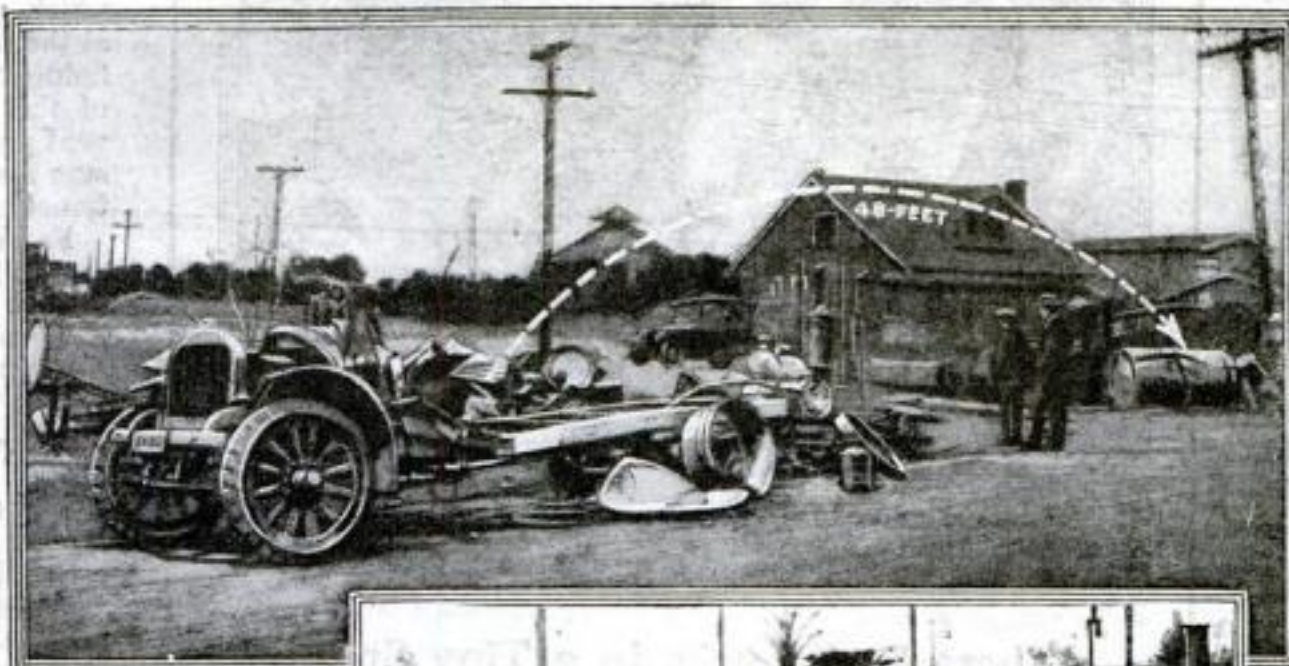
THROUGH the deaths of three motorists, all occurring within a week recently in widely separated parts of the country, attention of automotive engineers has been focused upon an odd but deadly peril in the gasoline tanks of automobiles. It is the danger of explosion and fire from the ignition of gasoline fumes by static electricity.

The tremendous scope of this newly discovered danger is apparent when we realize that more than 11,500,000 automobiles in daily use in the United States consume annually almost 3,500,000,000 gallons of gasoline—a fluid more dangerous than dynamite if not carefully handled.

Many Fires

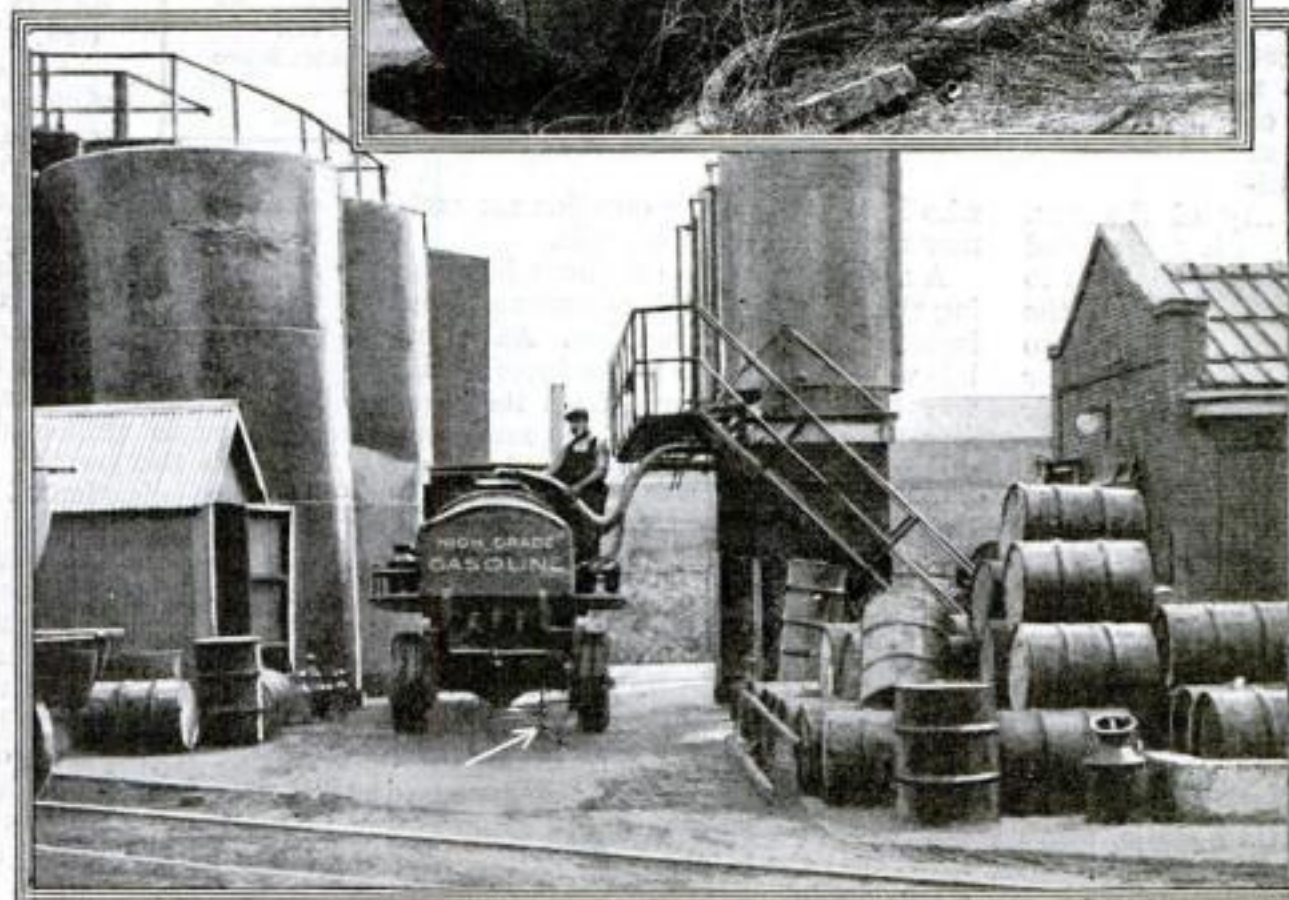
Organizations concerned directly or indirectly with fire perils suddenly have discovered that many disastrous fires, the origin of which was shrouded in mystery, actually were caused by static sparks coming in contact with the fumes of gasoline. As a result they are hastening to perfect preventive measures that will lessen this real source of property damage and death.

The American Petroleum Insti-



Courtesy National Board of Fire Underwriters

These photographs show how a huge gasoline tank truck was demolished by an explosion due to static electricity at a way-side service station in Downey, Calif. The steel tank at the right was blown 48 feet



Protecting a tank truck from static sparks. Arrow points to dragging chain attached to chassis. This serves as a

ground connection to carry off static electricity generated by friction of gasoline flowing through filling hose

tute has forwarded a comprehensive questionnaire on the subject to oil producers and dealers in an effort to standardize scientific methods of protecting gasoline tanks and tank wagons from the hazards of static. The National Board of Fire Underwriters has issued a bulletin explaining in detail the fire danger that always accompanies gasoline.

The American Society of Electrical Engineers and the United States Bureau of Standards have been designated by the American Engineering Standards Committee as a joint committee to formulate codes for the protection of gasoline against lightning, and of course, static, which is potential lightning in miniature. The gravity of the problem is revealed by such activities as these.

What Is Static?

Static electricity may be generated in an infinite number of ways. Wherever there is friction it is likely to be produced. It is static that crackles in your hair when you apply a rubber comb in the winter-time. It is static that causes sparks to jump from your fingers when you touch a metal object or the hand of another person after walking across a carpeted floor. Usually these sparks will do no harm; but, if generated where gasoline vapor has combined with the air in explosive proportion—above the gas tank of

Courtesy Sinclair Consolidated Oil Co.

your car, or in any garage, service station, filling station, dry-cleaning establishment; in fact, anywhere where gasoline is used—static sparks may cause disastrous fires and explosions.

How easily and peculiarly static electricity may be generated with dangerous effect is shown by an incident last winter in a city of the Middle West. A physician, roused from his bed by an urgent night call, donned a fur-lined overcoat and rubber boots. He walked to his garage, and as he started to enter his automobile, there was a blinding flash, and an explosion. The machine burst into flames. The automobile was destroyed and the physician badly burned.

Static electricity, generated by the rubbing of the fur of the coat against the rubber boots, was the cause of the fire. The rubber soles insulated the doctor from the ground, as he walked, causing the electricity to be stored up in his body as in a condenser. Then, when his hand approached the metal body of the machine, the charge was discharged in a spark that ignited the gasoline fumes rising from the tank of the car.

Why Gasoline Explodes

Liquid gasoline is not dangerous in itself. Confined in a tank or can, it is quite harmless. But the gas it gives off, combined in proper proportion with air, is highly explosive. Scientists have determined that the ignited vapor from a single gallon of gasoline can do as much damage as 83 pounds of dynamite. In fact, it is this very explosive force of air and gasoline that makes possible the powerful automobile engine.

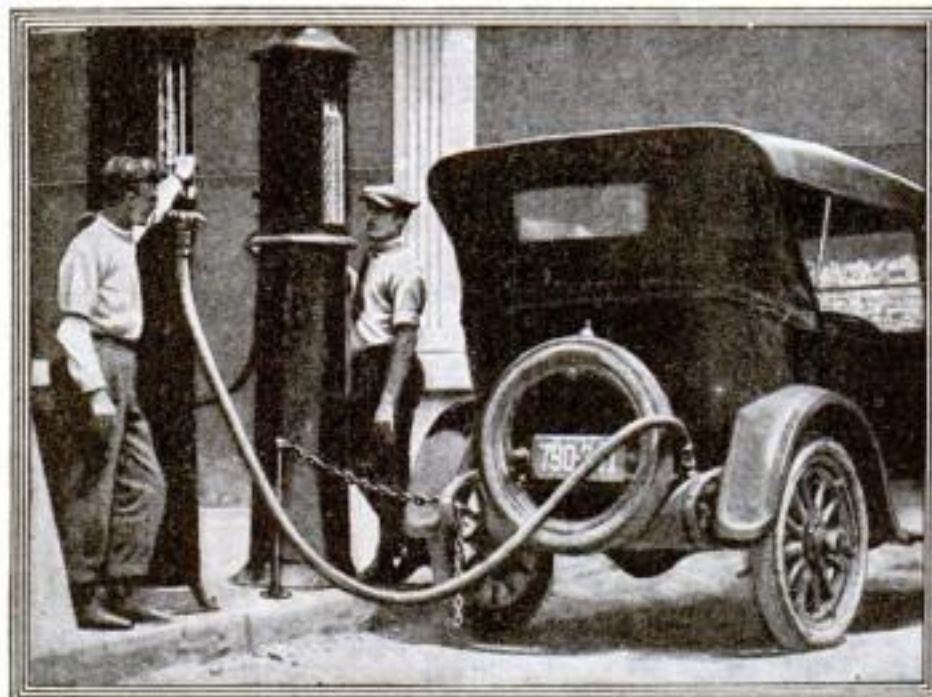
A slight spark only is necessary to ignite this gas—the glowing end of a cigarette, a burning bit of match, a weak discharge of static. The peril is magnified by a physical property of the gas. Because it is heavy, the gas is not carried away by the circulation of air, but falls to the lowest level it can find, settling to the floor and filling all crevices. It sinks into garage repair pits, where it may remain for days unless an extraordinary current of air carries it away.

Gasoline fumes that had settled in a repair pit caused a violent explosion in a garage in the Middle West a few weeks ago. A mechanic, entering the pit to drain a crankcase, was unable to budge the plug with his pliers. As he exerted more force, the pliers slipped, striking a bolt head and causing a spark. Immediately the fumes in the pit exploded, burning the workman severely and badly damaging the car.

Gasoline rushing through the hose at a wayside filling tank generates static, which passes through the metal nozzle into the metal parts of the automobile. There it is stored up because the car is insulated from the ground by its rubber tires. Touching the car with any conductor of electricity will cause the static to be discharged. The

hand of the attendant at the filling station, or the hose nozzle as it is withdrawn from the tank may supply such a conductor. The resultant static spark, occurring over an open gas tank and near a spot where a greater or less quantity of gasoline is spilled every day, is bound to be dangerous.

Many automobile fires and explosions have occurred under these circumstances. Formerly fires occurring when the gas supply of cars was being replenished were attributed to backfire from the motors, or some other mysterious cause, but those



A filling station safeguard. Here a ground chain, attached to a metal post, is thrown over a metal part of the car

Where Peril Lurks in a Tiny Spark

FIRE and explosion losses traceable to gasoline and oil, mounted in the United States from \$6,471,119 in 1918 to \$9,420,343 in 1921—an increase of nearly \$3,000,000 in three years. Experts now agree that a large percentage of these losses can be traced directly to the sparks of static electricity.

Like its big brother, lightning, static hurls its sparks at unexpected times and places. For that reason no specific rules can be offered as a sure safeguard against its dangers. Yet the average person, especially the automobile owner, will do well to observe a few general precautions: Don't allow uncovered gasoline to stand where sparks—from static or from other causes—may ignite the fumes and cause a disastrous explosion.

Guard against spilling gasoline on the floor of your garage or in your home. The gas it gives off is a potential destructive force more powerful than dynamite. A tiny spark is enough to set it off.

Carefully ventilate any inclosed place where gasoline fumes have been allowed to escape.

who have studied the question are certain now that the cause was static.

A noted automotive engineer investigating the danger of static reports an unusual incident of static generation. An automobile was backed up to a wire fence in such a way that the discharge from its exhaust struck against the wires. So much static was generated by the discharged gases impinging on the wire, that persons who touched the fence felt distinct shocks.

Static Responsible for Many Fires

Statistics of the damage done by gasoline fires caused by static are unavailable, because, as one engineer stated in a report to the Department of Agriculture on the question, "in most cases the evidence is destroyed." Fire authorities, however, agree that the total annual loss represents a considerable percentage of the total damage resulting from gasoline and oil fires. This damage, according to the latest reports of the National Board of Fire Underwriters, amounted to \$9,420,343 in 1921.

In Downey, Calif., static electricity, generated by gasoline flowing through a hose, recently caused a fire and explosion that killed eight persons. A 1700-gallon tank truck, filling the tanks at a service station, suddenly exploded. The tank was ripped from the chassis and hurled 48 feet through the air. Persons standing within 50 feet were enveloped in flames and their clothing burned from their bodies. Other persons 200 feet away were scorched and blistered and some of them thrown to the ground. All vegetation near the explosion was scorched.

The service station was demolished, and a frame bungalow that stood about 40 feet away was burned to the ground. Sunken concrete construction prevented the explosion of the five underground tanks in which gasoline was stored at the station, although the fluid was forced from four of the tanks through the vent pipes by internal pressure resulting from the external heat.

From a similar cause a garage in Marshfield, Wis., caught fire recently and automobiles valued at \$50,000 were destroyed.

Some Safeguards

For some time gasoline dealers have been using a simple but effective method of preventing fires of this sort. A chain is attached to the chassis of the gasoline tank truck and permitted to trail on the pavement. This supplies a ground connection for the truck and causes any static generated to flow harmlessly to the earth. The truck destroyed in the Downey explosion just mentioned was supplied with a ground chain, but faulty adjustment is believed to have been responsible for its failure to perform its function.

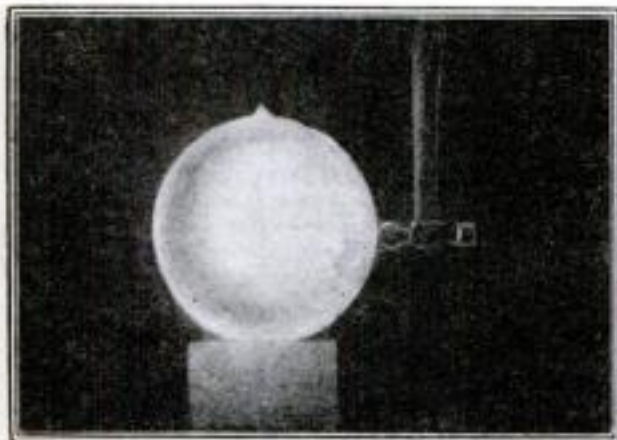
Some owners of gasoline filling stations recently have carried the ground chain idea further, supplying a

device which is used to ground every automobile that stops for gas. This consists simply of a metal chain attached to an iron pipe driven into the ground near the filling pump. When a car stops beside the pump, the attendant places the end of the chain on some metal part of the car. Thus the machine is protected should static develop as the gasoline flows into the tank.

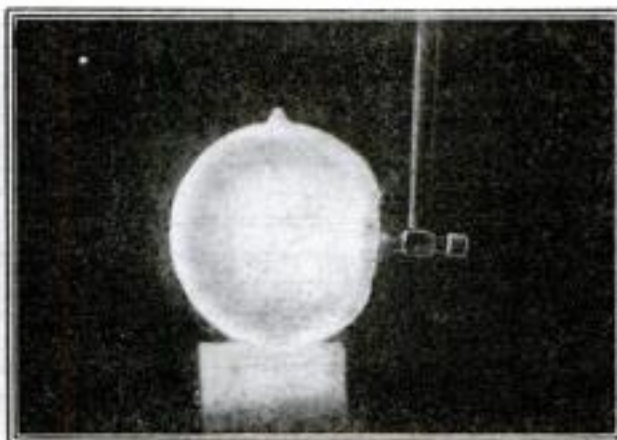
The elimination of static by grounding also is being practised on a smaller scale in dry cleaning establishments. Many fires occurring in these places have resulted from the generation of static by the rubbing of silk garments that are being cleaned. Experienced operators now dip their hands into the gasoline in which the garments are immersed and draw off the static charges, if any, by a grounded metal finger ring. This practice prevents the creation of a spark at the surface of the gasoline where it might cause a fire. Since static is generated in dry weather more readily than in damp weather, much of the danger in cleaning establishments is eliminated by discharging steam into the workroom.

High-Speed Movies—5000 a Second

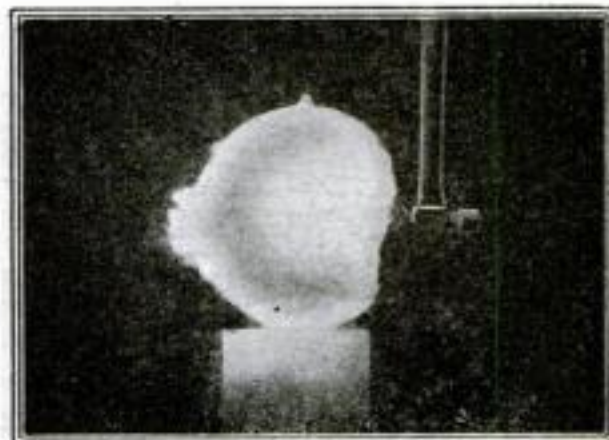
Marvelous New Camera Watches a Hammer Smash a Vacuum Bulb



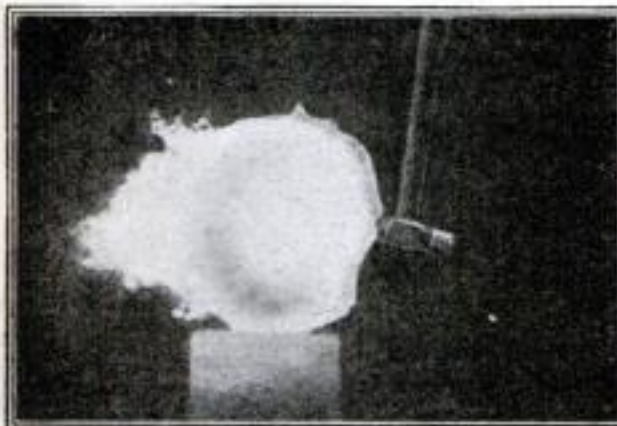
Photographed at the instant of impact



Appearance after 8/2500 of a second



Inrush of air breaks opposite side



The impact side still little altered



The whole bulb is crumbling now



1/100 of a second after impact

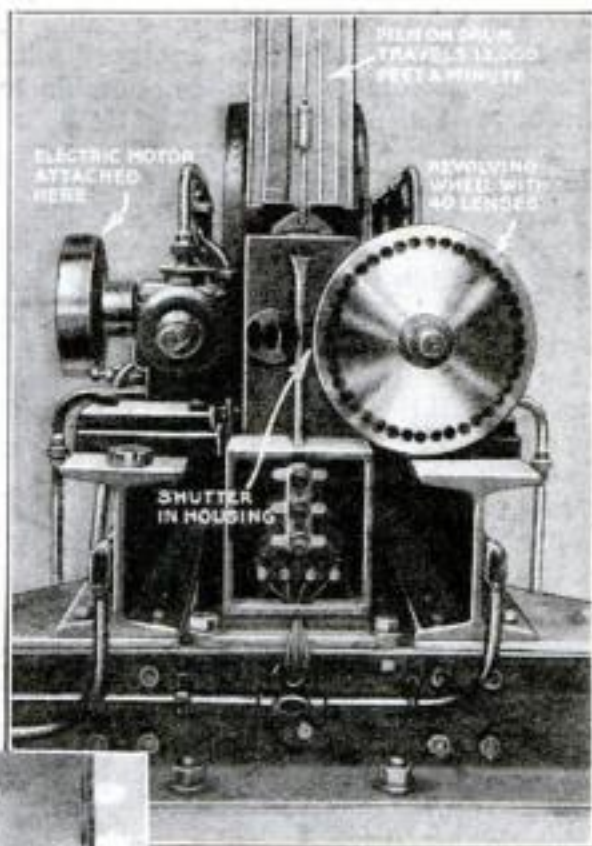
SIMULTANEOUSLY from the United States and England has come announcement of the invention of two revolutionary types of "slow motion" moving-picture cameras, capable respectively of making 3200 and 5000 exposures a second.

This permits the photographing in elaborate detail of actions the unaided eye cannot discern.

The bursting of a shell against armor plate, for example, which occupies less than one fiftieth of a second, by these wonderful cameras can be photographed in 100 pictures, which at normal projecting speed would be run off on a screen in between six and seven seconds. This enables scientific study to be made of each stage of a process that the fastest cameras hitherto devised have pictured as instantaneous.

Under the eye of the super-high-speed camera a rubber ball dropped to the ground is shown to be flattened almost into a hemisphere at the moment of impact, a circumstance which, by showing resiliency in detail, is of scientific value to tire manufacturers in deciding on the design and construction of their products. Other secrets of rapid mechanical action that the cameras will disclose are expected to lead to industrial and scientific improvements.

The American machine was developed by C. Francis Jenkins, of Washington, D. C. The British camera is known as the Heape-Gryll rapid cinema machine. They are large contrivances (weight of the English machine is four tons) operated by electric motors.



This British high-speed movie camera photographs "instantaneous" movements, making 5000 exposures a second. A section of this camera film is shown at left



Movie film; showing how a rubber ball flattens at instant of impact

The two machines are quite dissimilar in operation.

In the Heape and Gryll camera, rolls of film are wound about each rim of a drum 68 inches in diameter. Before each film and at right angles to the turn of the drum, revolves a wheel containing 40 lenses, geared and sized to produce pictures three quarters of an inch deep, the standard size of motion-picture "frames" or images. Between the lens wheels and the film is the shutter, the entire mechan-

ism being operated by the one motor. Single exposures, when the machine is operating at maximum speed, are never slower than 1/100,000 of a second.

Giant searchlights and chemical flashes are employed to furnish light. In photographing such things as the explosion of a shell, the shell itself severs a wire in flight. This causes the camera to start at the precise moment of explosion, as the human hand is too slow to operate the switch.

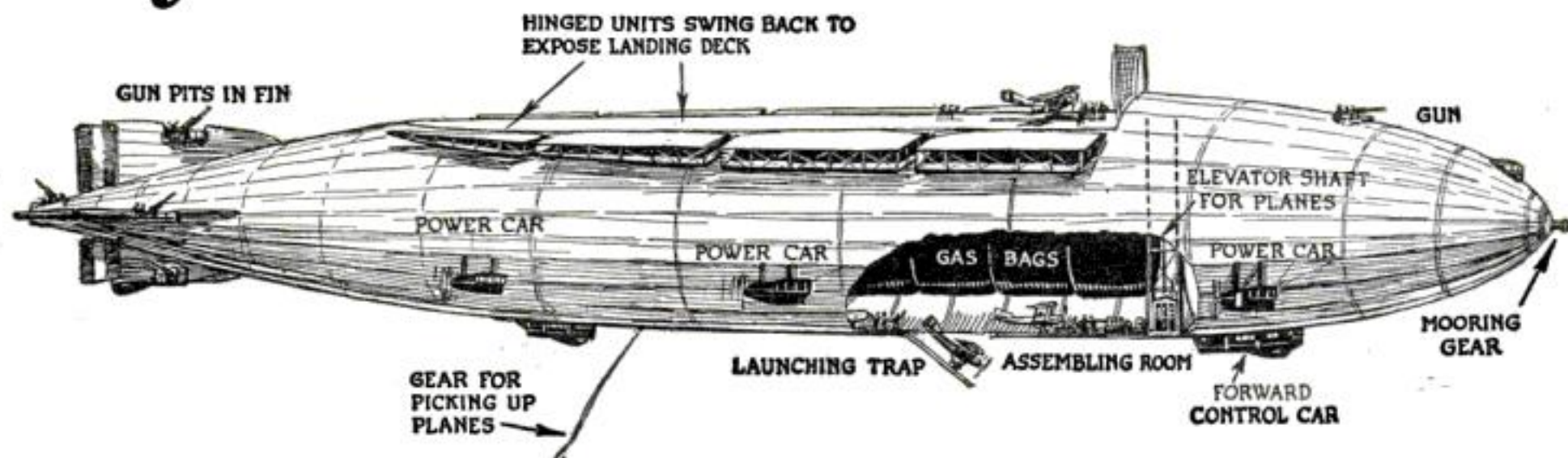
The Jenkins machine is smaller and simpler. It has a stationary lens and no shutter, and the movement of the film is continuous. Mr. Jenkins obviates a shutter and the necessity of halting the film each time it is exposed, by causing the beam of light that carries the projected image of the object being photographed to be bent progressively by a prism in the direction of the movement of the film. In short, the beam of light moves with the film and at precisely the same speed, flashing back to a new section of film each time an exposure is made.

The Scientific Detective

SCIENCE is making capture and punishment of the criminal so certain that eventually deliberate crime will disappear from the earth.

Such is the amazing prediction of Richard E. Enright, Police Commissioner of New York City. In a fascinating article written especially for the November POPULAR SCIENCE MONTHLY, Mr. Enright will tell how discoveries and inventions have made the modern detective a real scientist, eclipsing the exploits of *Sherlock Holmes* and other detective heroes of fiction.

Sky Leviathans of Tomorrow



Above is a diagrammatic representation of a possible monster plane-carrying airship of the future. In the accompanying article Rear-Admiral Moffett predicts airships more than

900 feet long. Notice how hinged cover units are swung back to expose a spacious landing deck for airplanes. Alighting, the planes would be lowered into the body of the ship

By Rear-Admiral William A. Moffett

Chief of the Bureau of Aeronautics, United States Navy

SHIPS of the sea have built empires, altered the destinies of nations, and exerted a profound influence on history through uncounted centuries. With the dawn of the twentieth century, ships of the air have come as a new challenger of time and space, and their influence upon the trend of world events is today one of the most potent factors in world progress and development.

Yesterday we crossed an ocean, today a continent; tomorrow we circle the globe. New routes for commerce open up by way of the polar air routes. London and Tokio are drawn together as by magic, and man, creeping on the earth, looks to the sky and reads there the story of a new era.

It requires no great tax on the imagination to picture some of the developments of air transportation which we may expect to see even in our brief span.

Larger Dirigibles to Be Built

The Navy has built at Lakehurst, N. J., the first rigid airship ever constructed in the United States—the ZR-1. It has been called a giant ship of the air—over 2,000,000 cubic feet of gas will be required to inflate it. It is as large as ocean-going steamers. It can carry a useful load of 35,000 pounds, exclusive of crew and supplies, and withal is mediocre in size and inferior in performance to similar ships that may be expected to follow.

Consider a ship of 5,000,000 cubic feet. Such ships now are being planned abroad. They would equal the size of the *Leviathan*, with a length of 900 feet and more and a diameter greater than the beam of that great vessel. They will carry a weight in fuel and other useful loading of more than 60 tons and could cruise halfway around the earth without a stop. Airplanes could be carried on them as are lifeboats on ocean-going vessels. These planes could land on a deck on top of the airship and be launched from it, carrying passengers for wayside destinations. They could be designed to carry a regiment of troops, and a fleet of them could transport an army to the ends of the earth, in time that could be reckoned in hours.

Imagination—but not too much of it.

Airplanes already have been carried by airships, launched from them, picked up by

them. Polar air routes for short cuts by air commerce are considered the most logical development of dependable aeronautics. This assertion we have from such practical men of science as the noted explorer, Vilhjalmur Stefansson. And England will weld together her empire overseas with giant airships, capable of traveling 10,000 miles and equipped with passenger accommodations comparable to those of the finest transatlantic steamships.

In the light of what has been done by airships operating with airplanes, this development rivals in interest anything that has gone before in aeronautics. The future airship, developed for naval use, will carry a sting that will make it one of the most formidable contenders for supremacy of the air, sea, and earth that has ever been conceived. Allowing 60 tons of useful load to our air giant, we may set aside one half of this for fuel, which will leave 30 tons for planes, landing gear, guns, ammunition, and bombs. Superior types of fighting planes now in service use weigh less than a ton each. Other types of planes have been developed which weigh less than 1000 pounds.

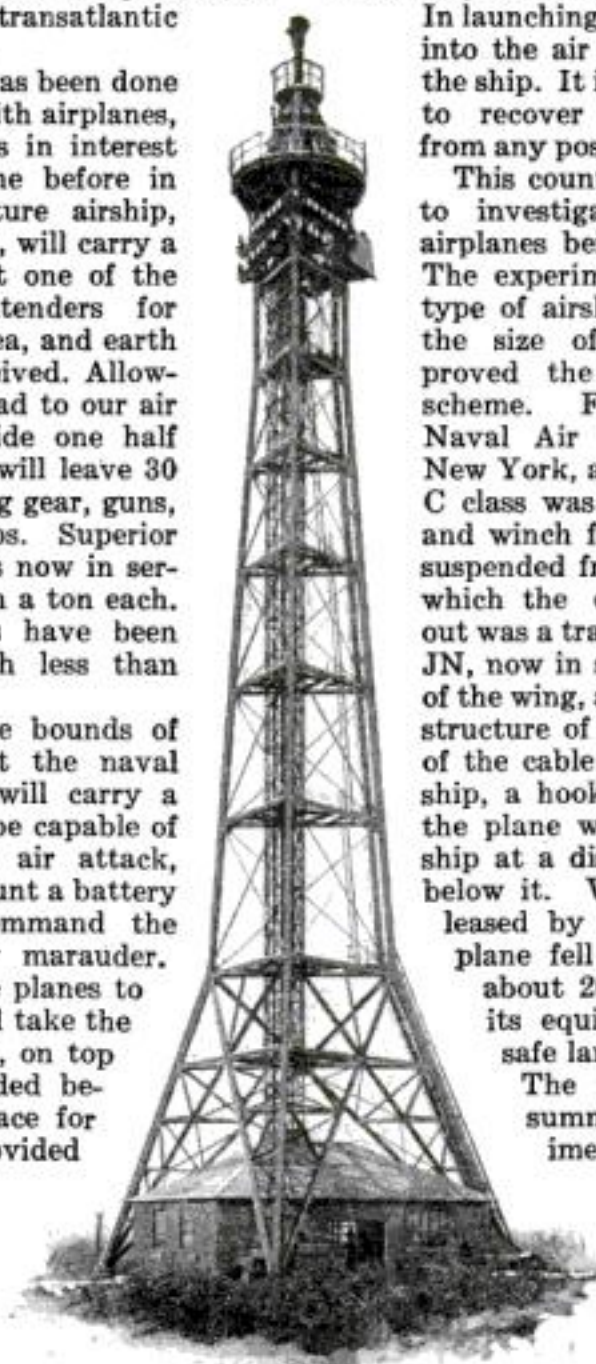
It is well within the bounds of reason to predict that the naval airship of the future will carry a dozen planes that will be capable of defending her against air attack, and in addition will mount a battery of guns that will command the respect of any enemy marauder. Means of returning the planes to the parent airship could take the form of a landing deck, on top of the ship or suspended beneath it. Stowage space for the fighters could be provided in the body of the ship along the keel line. The launching of them is merely a matter of pushing the planes off into space, where they can recover themselves with the ease of a bird thrown into the air.

One of the problems involved is that of keeping the ship's center of gravity below the center line of the envelope. Any extensive structure on the top of the airship involving weight would affect the stability and performance adversely. To offset this obvious difficulty, planes once landed could be quickly disassembled and the fuselage and wings quickly passed through a well in the body of the ship to the stowage space.

In launching, they would be dropped into the air from the under side of the ship. It is no trick among airmen to recover equilibrium in flight from any position.

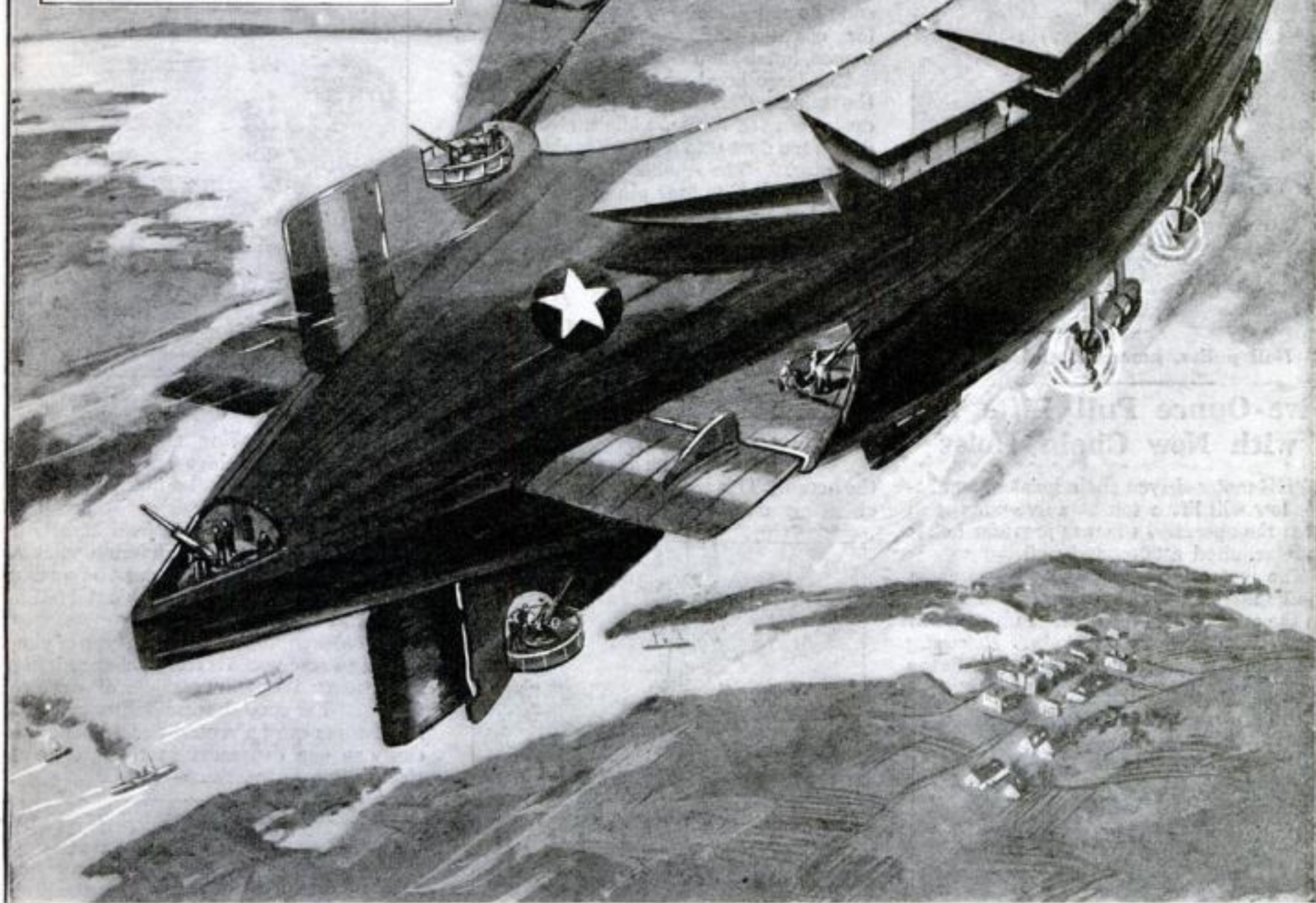
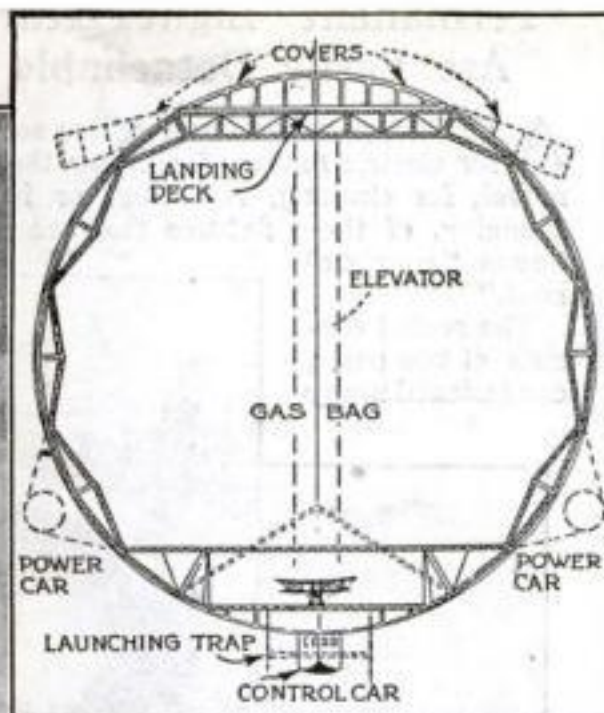
This country was among the first to investigate the possibility of airplanes being carried by airships. The experiment, conducted with a type of airship less than one tenth the size of those now building, proved the practicability of the scheme. Four years ago at the Naval Air Station in Rockaway, New York, a non-rigid airship of the C class was equipped with a cable and winch for carrying an airplane suspended from it. The plane with which the experiment was carried out was a training type known as the JN, now in service use. On the top of the wing, a ring was secured to the structure of the plane. On the end of the cable let down from the airship, a hook engaged the ring and the plane was suspended from the ship at a distance of about 50 feet below it. When the hook was released by a tripping device, the plane fell a vertical distance of about 200 feet, then recovered its equilibrium and flew to a safe landing.

The following year, in the summer of 1920, these experiments were carried further by the British. The R-33, a sister ship of the one that made a round trip from England to the United States in 1919, carried out experiments in releasing, carrying, and picking up an airplane by means of a



This towering mooring mast, has been constructed recently at Lakehurst, N. J., to anchor the first American-made dirigible the ZR-1

A Dreadnaught of the Clouds



Our artist's conception of the aerial war-ship of tomorrow, described by Admiral Moffett. Diagram shows cross section

cable let down from the airship. These tests were similar to those carried on at Rockaway the previous summer, but were more extensive.

The plane, a Sopwith Camel, was fitted with a bridle terminating in a ring that extended above the top wing of the plane two or three feet. When the airship picked up the plane, the speeds of the two were approximately the same and it was a simple matter to engage the ring on the plane with the hook at the end of the cable. The plane was released by tripping the hook and the pilot dived, started his motor and flew away.

Until now one hazard in airship operation always has stalked like a specter at the heels of this development. Hydrogen-inflated ships carry with them the ever-present danger of fire. Many aerial disasters have been traceable to this.

The United States, possessing as it does

the only extensive helium supply in the world, is particularly favored by nature. Helium, an inert gas, is not inflammable. It has but little less than the buoyancy of hydrogen and can be produced at a cost which, though higher than that of hydrogen, is inconsequential compared with the safety and dependability gained.

We Must Conserve Helium Supply

However, we cannot afford to be as prodigal with this gift of nature as we have been with others. A well considered program of conservation of this valuable product is essential to our national welfare, from a commercial standpoint as well as from that of national defense.

The helium airship will make this form of travel safe to a degree never before possible. It will insure low insurance rates on merchandise carried by airships.

From a military point of view, helium has placed a new complexion on the airship-airplane controversy. The airship filled with helium and defended by guns and airplanes, will be in effect a battleship with the sky as a limit. As the battleship is subdivided into watertight compartments, so the airship is made up of a number of gas cells. When a watertight compartment is punctured, the ship does not sink. This method of construction has saved ships even against the destructive effect of torpedo explosion. So the puncturing of a gas cell in the airship will not spell disaster. We may see these battleships of the air, riddled with shells, still fighting gallantly on to victory.

As a basis for the future of airship development in this country, the Navy, in constructing the ZR-1, is building wisely and well. America should be in a position to point the way to the world.

New Combination Tool Is a Mechanical Friend



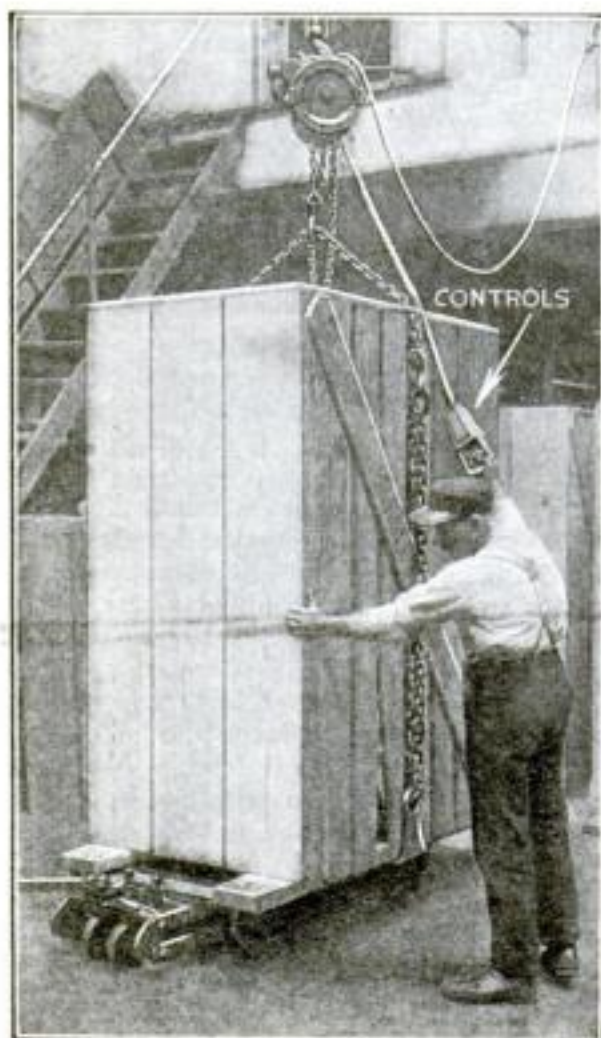
A COMBINATION tool, of remarkable utility, consists simply of a steel bar hooked at one end, with a small hammer-head projection. It serves either as a nail puller, hammer, chisel, or crowbar.

Nail puller, hammer, and crowbar

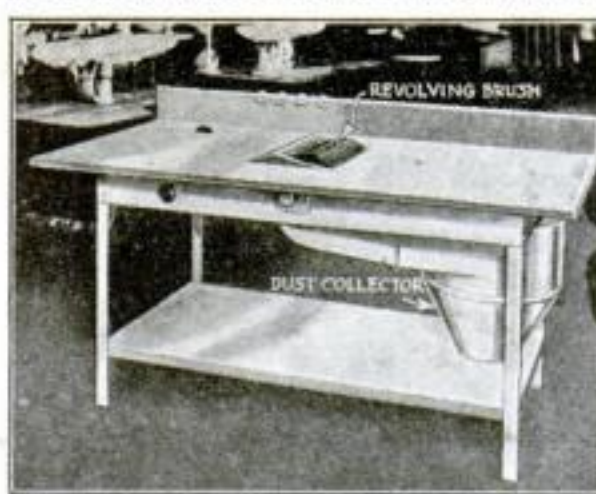
Five-Ounce Pull Lifts Ton with New Chain Hoist

THE motor-driven chain hoist shown below will lift a ton at a five-ounce pull from the operator, whereas previous hoists have required a 90-pound pull.

The motor is controlled by a switch in the handle held by the operator. Turning on the current lifts the load. Pulling down on the handle winds the chain. Releasing the handle causes the load to stop, while the motor continues running.



How one man lifts a ton load



Inexpensive Dry Cleaning with Diminutive Plant

A MACHINE that makes possible a dry cleaning service without the expense of skilled labor and the employment of complicated machinery has been designed for use by tailoring shops, dry-goods houses, hotels, and cleaning shops.

The large brush shown in the center of the table revolves rapidly, loosening the dust from the fabric, while a strong draft draws the dust into a centrifugal type dust collector. The smaller brush is used for "spotting." The four plungers at the left end of the dash operate fluid containers. The dust collector is shown below the table.

Time Saved, Colds Avoided by This Built-In Mailbox

AN INGENUOUS accessory for the home is a newly invented, built-in mailbox. The box is so arranged that a letter, dropped into the slot on the outside, can be removed through a small door within the house. This will eliminate the necessity of going out of doors when the post-



Old and new types of mailbox

How Campers May Purify Unsafe Drinking Water

CAMPERS in districts where streams may be polluted will be relieved to learn that the Army Medical School at Washington, D. C., has evolved a handy method of purifying suspected water.

One or two drops of tincture of iodine will vanquish all the germs in a quart of unsafe water within from 20 to 30 minutes, according to this authority. Just shake the water container well. The greatly diluted iodine cannot be tasted.

"Permanent" Light Fixtures Are Easily Detachable

A NEW type of wall and ceiling socket for electric fixtures facilitates the removal, for cleaning, replacing, or interchanging, of those fixtures that we now term "permanent."

The socket consists of two parts, one fastened firmly



Adapted to two types of fixtures

to the wall or ceiling and the other to the fixture. The plugs have large binding screws with which the fixture wires are connected. The fixture is suspended from a hook in the plug and is held tightly in place by a spring catch. Before the fixture can be removed, this catch must be sprung. This feature prevents the accidental falling of a bowl or wall light.

In homes equipped with this type of plug, lighting arrangements can be changed in a short time without the services of an electrician. For special occasions, extra lighting fixtures can be rented and installed as easily as one can screw in the lead to an electric iron or toaster.

Automatic Pressure Kettle

MADE of enameled steel, a new pressure kettle that seals itself when the pressure within rises has been added to the list of new labor-saving utensils.

A stack of pans is held in a rack that fits in the kettle. The cover fits tightly and is provided with a pressure gage and a safety valve. These prevent the kettle from blowing up under too high a pressure. When the pressure reaches the danger point, the kettle by a loud knocking warns the housewife.



The parts of the pressure kettle



Folding Camp Stove Burns Gasoline from Car

HOME cooking comforts are provided the camper or motor tourist by the folding camp stove shown above. It burns gasoline, permitting the use of fuel extracted from the tank of the motor car.

A windshield, warming shelf, detachable pressed steel legs, and a two-burner iron grate are features of the stove, which may be folded to 4½ by 10½ by 19 inches for carrying. The entire outfit, including fuel tank, weighs only a few pounds.

Tiny Microscope Magnifies Object 225 Times

A SMALL pocket microscope, only four inches long and weighing but 15 ounces, recently perfected, is capable of magnifying an object 225 times its actual size. The instrument consists of a cylindri-



The pocket microscope extended and collapsed

cal base and stand into which two other cylinders telescope. Beneath the lower lens is a hollow stage upon which the material to

be inspected is placed. Light reflected from a concave mirror underneath, illuminates the material. When completely closed, the degree of magnification is 50 times.

To increase this, it is necessary only to pull out either of the two cylinders to a point where a scale indicates the desired number. By pulling out both as far as they will go, an object is magnified 225 times. If the lower cylinder is removed, this is cut in half, thus giving a magnification of 25 times.

The instrument has been designed not only for use in laboratories, but as a field instrument for workers who find it necessary to observe minutely the condition of wood or metal with which they are working.

Rake-Mower Trims Edges of Lawn

PERSONS who mow their own lawns usually are compelled to use grass shears to supplement the work of their mowers in trimming the growth at the sides of buildings and fences or around trees or flower beds. Now a Michigan manufacturer has perfected an ingenious small mower, no larger than a rake, that will cut grass any place where a rake might be thrust.

The cutting is done by a set of eight sharp-edged cutting disks arranged along the front and operated by driving wheels at the rear. The driving wheels do not pass over the grass until it has been cut. The revolving disks will cut tall grass as well as short in a 16-inch swath.

Holding the handle in a natural position will cut the grass short enough for good appearance and the promotion of growth, yet will not permit the driving wheels or cutters to pick up twigs or small stones.

The new mower is silent in operation



This easily operated lawn trimmer has a series of eight revolving cutting disks (shown in inset) that shear the grass

and is light in weight. The blades are removable for sharpening or for the substitution of new ones. The rake is especially adaptable for trimming steep terraces.

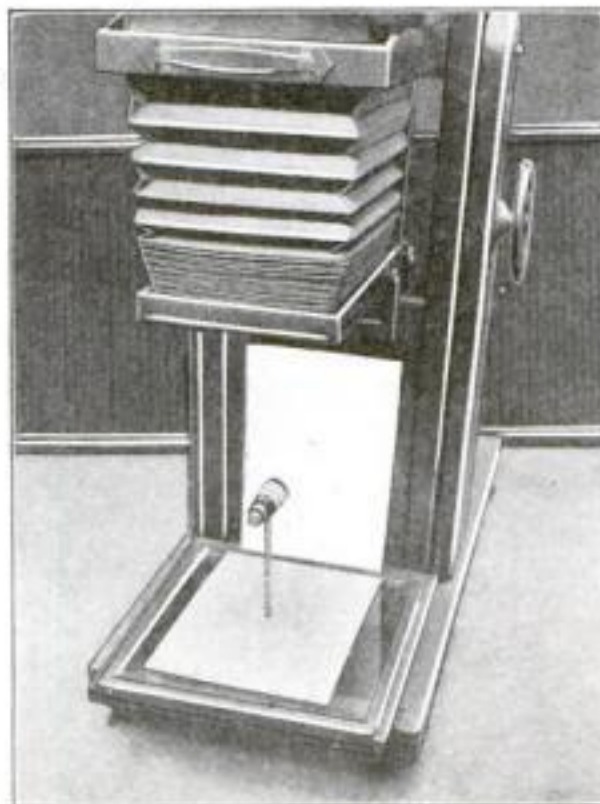
Supporting Small Objects before the Camera

GRAY backgrounds often are desirable in photographing small objects in the studio, but almost invariably the photographer resorts to the white background to obviate the many difficulties otherwise encountered. If the object is placed on a clear glass with the gray card underneath, he often gets reflections across the plate. If it is placed directly on the gray card, he gets disagreeable shadows and also an un-

pleasant mottled appearance, since each little corrugation in the cardboard stands out plainly in the photograph.

To avoid these difficulties there has been devised an invisible support method, as shown in the photograph. This is merely a nine-inch section of curtain rod, either soldered to a metal base or set firmly in a wooden one, which is pushed through the center of the cardboard desired for the background. A T-joint can be made to fit in the top end of the rod and this with the addition of a little modeling clay, will support any small object readily. If a long or heavy object is to be photographed, two such supports can be employed.

With this method there is no chance for reflections, and shadows are eliminated.



Photographing a small bottle on a gray background, using the invisible support

Wall Holder for Telephone Has Coin Box and Pad

THIS handy wall telephone holder, carries a little coin container to remind neighbors that telephone service costs money. A conveniently arranged pad may be used for notes or a ready reference directory of numbers.



The compact holder

INTERESTING PEOPLE and Their Hobbies



PEANUT MANIKINS in lifelike poses are turned out by the dozen by George Berryman, manager of a Seattle, Wash., department store, after office hours. Each little form he makes from two peanuts, odd pieces of wire, glue, and paper



BUILDING SHIP MODELS is the hobby of Hobart Bosworth, famous actor of stage and screen, during his spare hours. One of his creations, a full rigged ship, complete in miniature detail, is shown above. He carries his handiwork and a set of tools about with him in a special trunk. Theatrical dressing rooms serve as his workshops



INDIAN HISTORY is being carved in elaborate figures on a huge cedar pole by Will Shelton, chief of the Snohomish tribe and head of the Tulalip Indian Reservation School in Washington. Already the chief has spent 3600 hours "writing" his tribe's history. When completed, the totem pole will stand 100 feet high

ANATOMY AND ART go hand in hand in the workshop of Gustave Van Bouchaute, a physician of Paris, France, who leaves his practice long enough to work as a sculptor, modeling remarkable reproductions of the parts of the human body. He is shown below adding the finishing touches to a model of a pair of lungs



A VIGOROUS ATHLETE AT 72, Prof. Gilbert Ellis Bailey, professor of geology at the University of Southern California, goes to the mat with the huskiest of his students. Wrestling, one of the most strenuous of sports, has kept him young, and in good health, he says

Oilwell Fire Snuffed like Candle

Ingenious Cap Smothers Fatal Texas Blaze



The Hughes-McKie oilwell fire near Corsicana, Tex., as seen from a distance. Thirteen men were killed and \$60,000 in oil was consumed



C. T. Kinley (at left) and the suit used in recovering bodies of oil fire victims. The suit is made of several thicknesses of fireproof asbestos cloth

MODERN invention rarely has been put to a more dramatic use than it was a few weeks ago, when a devastating fire, which had killed 13 men and had consumed more than \$20,000 worth of oil a day for three days, was extinguished by a giant candle snuffer devised for the emergency by an oilwell foreman.

This was the first time in the history of oilwell drilling that a burning oilwell was capped so successfully as to extinguish the fire.

The fire broke out at the Hughes-McKie well near Corsicana, Tex. So fierce were the flames, and so suddenly did they burst forth, that 13 workmen were burned to death before they could flee. For the next three days and nights more than 100 workmen, wearing special asbestos suits, labored unceasingly to recover the charred bones of their comrades and to extinguish the fire. Just when there seemed no hope of halting the fire before the entire capacity of the well should be consumed, D. L. Kelly, trouble shooter for the J. K. Hughes Company, appeared with the request that he be permitted to try his snuffer. For months he had been working on this invention, and had rushed it to completion after the Hughes-McKie fire started.

Kelly's invention is a huge cap supported by an iron tripod, from which it is swung on chains. Leading from the cap is a perpendicular pipe 10 inches in diameter and eight feet high, and a smaller lateral pipe forming

a T-joint with the main pipe. In the lateral pipe, at this joint, is a gate valve. A second gate valve is located near the top of the main pipe.

The entire device was hauled by an endless tread tractor to the burning well, where the tripod was erected. With the assistance of eight men, Kelly swung the cap over the mouth of the well, dropped it into place and made it practically airtight by means of a casing of sheet metal. Then the gate



Above: The well burning at its greatest intensity. This great column of flame and smoke finally was snuffed out by the ingenious capping mechanism, shown at the left, with its inventor, D. L. Kelly. Closing of the upper valve smothered the flames



valve high in the main pipe was closed slowly, completely shutting off oxygen from the oil and smothering the flames.

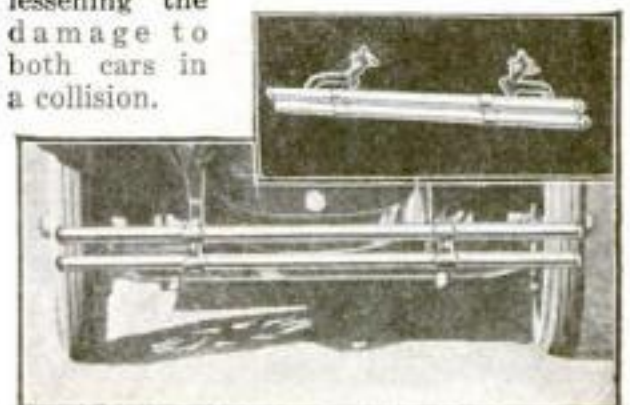
At the same moment the valve in the lateral pipe was opened, permitting unburned oil and gas under pressure to escape through this pipe, which emptied into a pit more than 100 feet away. Almost the instant the valve on the cap was closed the fire flickered out.

Repairs to the burned well are now under way, and it is expected its operation will be resumed shortly. Oil men of the Texas and other districts have shown much interest in Kelly's device since its successful demonstration. In fact, its inventor expects it will be added to the equipment of every oilfield as a protection against the greatest menace of the industry—fire.

Rubber Bumper Absorbs Jolts in Collision

THE chance of serious accident or disaster from bumping into any obstacle is said to have been lessened greatly by a new rubber bumper for automobiles recently put on the market. It is made of high-carbon steel tubing, coated with rubber of the kind used in the treads of tires, and it is attached to the automobile by strong U-shaped springs.

The hollow steel provides strength, while the rubber coating softens the impact, lessening the damage to both cars in a collision.



The rubber bumper, attached with springs



The camera of the memory. Through our eyes we register indelible impressions which the mind files away

Are You Using All of Your Brains?

An Article on Memory—and How to Improve It

By James J. Walsh,
M.D., Ph.D.

*Professor of Physiological
Psychology, Cathedral
College, New York City*

A FEW weeks ago the New York newspapers, in reporting a trial in which a noted criminal lawyer appeared as counsel for the defense, commented on the remarkable feats of memory which he performed many times during the closing days of the trial. Although he had made no notes at any time during the trial, he was able to repeat, word for word, just as they had been uttered by the witnesses, lengthy pieces of testimony that had been given days before.

What he repeated was not merely the gist of what had been said. It was the exact, verbatim testimony. His feat of memory won the case for the lawyer and saved his client from prison.

Amazing though this may seem to persons who have difficulty recalling names, addresses, and telephone numbers, actually it is no unique performance. Successful men almost invariably have retentive memories—storehouses of facts, assembled in order and properly indexed so that they may be found easily and put into use when needed.

Washington and Napoleon are said to have known thousands of men in their armies by name. Theodore Roosevelt has been credited with having remembered everything he ever read. Abraham Lincoln had at his fingers' ends every fact he ever learned. Pascal, the great scientist, could repeat the entire Bible. Shakespeare had a vocabulary of 15,000 words, Milton of some 10,000. Memory is nearly always an attribute of the great, for, as Bacon sums it up, "All knowledge is but remembrance."

And yet a good memory is not the exclusive possession of great men. Thousands of people in ordinary walks of life hold in their minds vast collections of facts of various sorts which they can produce at any time they wish. The telephone operator in the office of a large corporation will remember hundreds of telephone numbers. The clerk at the information desk in the office of a great public utility company in downtown New York City, can tell you instantly the number of the room in which any of the company's 3000 employees is to be found. A hotel manager in the Middle



In remembering a flower, such as the new pure white amaryllis (at left), named for Mrs. Warren G. Harding, we associate the name with the senses of sight and smell, which fix it firmly in our minds

Eight Rules for Memory

HERE are eight simple rules which, Doctor Walsh says, should help you to train your memory:

1. Learn to concentrate.
2. Use as many senses as possible in obtaining impressions of an object.
3. Develop, by patient, systematic exercise, the faculties that seem to be weak.
4. Try to make your first impressions of an object permanent.
5. Revive your impressions frequently. After a vacation actors must rehearse rôles in which they have appeared many times.
6. Have confidence in your memory. Don't rely too much on pencilled notes or on the memories of others.
7. Establish as many associations as possible for your impressions. In attempting to remember a fact, satisfy yourself as to what it is, whence it comes, where, when, how, and why it was made, and whither it is going.
8. Make your memory training practical and useful. A telephone operator, for example, might use her time better in committing telephone numbers to memory than in memorizing English verse.

West can greet by name any one of the thousands of persons who have registered in the hotel since he has been in charge. An office boy on a Chicago newspaper knows *v i r t u a l l y* every street in the city by location and name, and has on the tip of his tongue a vast fund of other information about the city—the locations and numbers of fire alarm boxes, fire houses, and police stations, the

street numbers of important buildings.

All of us cannot become Shakespeares, or Pascals, or Napoleons, but by systematic, intelligent exercise we can develop our memories so that they will be of real value to us in our contact with the world.

The training of the memory must be undertaken with the idea of aiding nature, not compelling her to alter her process of recalling past impressions to the mind. An example probably will aid me in explaining Nature's method of actuating the memory.

You see on your desk pad a brief note—possibly only a name, an address, or a single word. It recalls to you instantly a business engagement. The train of thought by which you connected the engagement with the entry on your pad, was started voluntarily. This voluntary action of the memory is called recollection.

You take a streetcar to keep the engagement. While riding on the car, you suddenly find yourself thinking of some event of your boyhood. The thought apparently has just "popped into your mind" from nowhere. This involuntary manifestation of memory is called remembrance.

Actually, there was no difference at all between these two mental processes. You may not have been aware of it, but something occurred while you were riding on that car to make you remember the incident that seemed to enter your mind from nowhere. A man sitting opposite you may have been wearing a suit of a peculiar shade of brown, which recalled a suit worn by some actor in the event which you thought you had forgotten. You may have heard a railroad whistle that



A child usually remembers a zebra as a striped horse and a giraffe as a horse with a long neck. This thinking in pictures and associating new impressions with old, is invaluable to memory in after life, says Doctor Walsh

recalled to you travel on trains, distant places, your boyhood home, the friends of your youth and at last the event that "popped into your mind." The train of thought occupied less than a second. You were not conscious of the intermediate steps, but they were there just the same.

You can see, then, how recollection and remembrance may be considered as the same process. This knowledge can aid us in increasing the powers of our memories.

Memory Never Relinquishes a Fact

Past events and impressions are stored up in what would seem to be various layers of our memory which, as recent observation demonstrates, never entirely relinquishes any fact that they receive. In other words, we never completely forget anything we have learned. Our problem, then, is to train our active mind to reproduce for us any desired fact at our will. That this can be accomplished has been proved conclusively many, many times. It is done through what is known as the law of association, which is the foundation of all systems of memory training. We must learn to associate facts that we know with the facts we are attempting to commit to memory, so that the recollection of one fact invariably will lead to the remembrance of the other.

Doggerel is useful in memory training, for rhyme and rhythm stick in the mind. Rhythm is especially applicable in remembering telephone numbers and names.

The first thing to be cultivated by a person who desires to improve his memory is the habit of attention. "Attention," Lowell says, "is the stuff that memory is made of, and genius is accumulated memory." Therefore, as a first step, learn to concentrate.

Perhaps you say you cannot remember faces, but if that is true, it is because you are not sufficiently interested in the new people you meet.

A Memory Feat

Henry Clay once called by name a man whom he had seen for a single day in a jury box 20 years before, despite the fact that an accident had disfigured the man's countenance in the interim. The man's profile had remained unchanged, and Clay had trained himself to remember faces through their dominating characteristics.

You can do much the same thing. Catalog in your mind the various types of faces—round, oval, long, bony,—and the various types of eyes, noses, chins, mouths, foreheads, and jaws; then fit each new face you see into its proper type and make mental note of the features in which it differs from other faces. Try to find some resemblance

between that face and the face of some one you know well. Leonardo da Vinci drew sketches of all possible faces and numbered them. Possibly you cannot do that, but you can make mental sketches of the faces you see and classify them according to their types.

In seeking to remember facts, think in pictures. A child remembers a zebra as a striped horse, and a giraffe as a long-

number—picture them in blue electric lights if that will make the picture more vivid. Then get the rhythm on the successive numerals fixed in your ears. The telephone number "Main eight six hundred" has just as definite a rhythm as the first line of the "Star Spangled Banner."

If remembering numbers is your chief difficulty, do simple sums in arithmetic as a pastime, to accustom yourself to dealing with numbers. An acquaintance of mine cured himself of the unfortunate habit of forgetting telephone numbers and addresses by a simple game with which he occupied himself when walking along the street.

An Exercise

He tried to commit to memory the numbers on the automobile license plates as the cars passed him. He varied this by trying to add up the numerals on each plate before the car was out of sight. A few months of that treatment cured him.

A similar cure may be practised by persons who find difficulty in remembering words. Learn a few lines of verse each day. When you are riding on

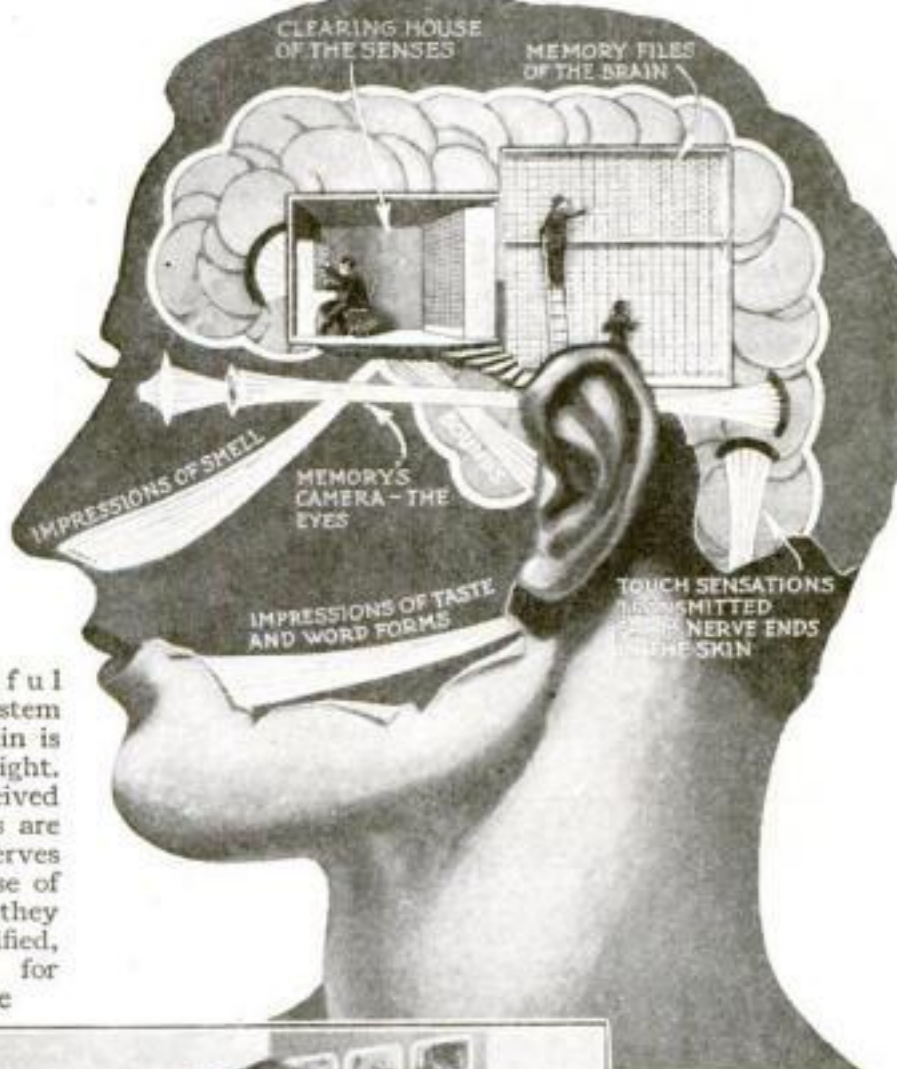
street cars, commit to memory the text of the advertising cards.

If you cannot remember names, attempt a classification of them similar to your classification of faces. If the names are of foreign origin, remember from what country they come. Fix their rhythm in your mind. Associate them with names that are similar. Names derived from such things as colors and animals suggest their own classifications. Other names may suggest pictures. In any case, spell the name to yourself and see the letters in your mind.

Is Genius "Accumulated Memory"?

The only method of remembering music that I know consists of hearing the music repeated many times. Chorus numbers on the stage are drummed into the minds of the performers by frequent repetition. Trained musicians, of course, can learn music simply by reading notes, as you would learn poetry. Josef Hofmann, the famous pianist, once learned a difficult and lengthy concerto from the notes during a short railway journey. A few hours later he played it at a public performance for the first time in his life entirely from memory. Once when the orchestral score for the "Midsummer Night's Dream" overture had been mislaid before a concert in London, the great Mendelssohn prepared the entire score from memory!

Geniuses such as these developed remarkable memories not only through tireless training, but largely through reliance on their memories. Early in their careers they learned to use their brains—all of them.



The wonderful memory filing system of the human brain is illustrated at the right. Impressions received by the five senses are transmitted by nerves to a clearing house of the mind, where they are sorted, classified, and filed away for future reference.



How a modern vocational bureau tests the memory by means of lettered cards and building blocks

necked horse. Try to bring every possible faculty and sense to bear on the storing up of a fact in your memory. You can use your sight and hearing always, your taste, feeling, and smell frequently. If you want to remember a number, picture in your mind the numerals that make up that

Baby's Canvas Bathtub Lightens Work

UNUSUALLY useful for the modern mother is this combination canvas bathtub and dressing table for the baby. It is designed to fit within the ordinary bathtub, and is supported by the sides of the tub. Not only is it sanitary for the baby because of a continuous flow of clean water, but it provides comfort for both mother and child.

After the large bathtub has been filled, the baby's tub is fitted in place and is ready for use. The infant nestles comfortably in a soft canvas bag that conforms to its body, while the mother, seated on a stool beside the tub, administers the bath.

Openings at the corners of the small tub allow free flow of water in and out, thereby assuring cleanliness and uniform temperature. The entire outfit is extremely light and can be carried easily from place to



After the bath the hinged cover serves as dressing table

place. It relieves the mother of tiresome bending and stooping and of carrying water for the bath.

The bathing bag dries almost instantly after water is removed from the bathtub. It is equipped with a hinged dressing table made of heavy canvas that covers the tub after the bath, and which, covered with a bath towel, makes a convenient place to lay the baby while he is being dressed.

Portable Radio Set Has no Aerial nor Ground

A PORTABLE radio set which, it is claimed, uses no ground and no aerial, is here shown. It is said to have picked up broadcasting stations 100 miles distant. A secret type of circuit using one amplifying tube, is the explanation given for the remarkable performance.

The photograph shows Miss Helen Conroy, of Brooklyn, N. Y., listening in during her lunch hour at City Hall Park.

Listening in with new portable receiving set, carried in a small case



Sheet-Music Pages Turned by Foot Pressure

ONE of the recent inventions is an automatic sheet-music turner, adapted to all sizes of pages. The sheets are engaged by clips of fine wire, and are turned when pressure is exerted on a pedal.



Pressure on pedal turns the pages

WHO are the world's ten greatest scientists?

From the whole field of science and from all the pages of history, which ten men stand out clearly above the thousands who have done great things, and why?

POPULAR SCIENCE MONTHLY put this question to the British scientist who has done perhaps more than any other one man in modern times to put the facts of science within the reach of the average man and woman—to J. Arthur Thomson, Regius Professor of Natural History in the University of Aberdeen and author of the tremendously popular work, "The Outline of Science."

In our next month's issue we will announce Professor Thomson's selections. He will tell in his own fascinating way why he has placed the names of these scientists in the list of the world's ten greatest.

Safety Platform Designed for Washing Windows

A NOVEL hanging platform that enables a person to wash the outside of upper-story windows in comfort and safety has been invented by James C. Brewster of Fort Madison, Ia. The device consists of a stand and cage formed of iron bars, with hooks or hangers that extend across the windowsill and engage the portion of the windowsill within the room.

Diagonal brace bars that are a part of the cage have downwardly curved ends that rest on the outer horizontal portion of the sill and function to hold the cage and stand level while it is occupied by the person washing the window.

The hooks holding the cage to the windowsill are made in two sections, hinged together. This makes it easy to fasten the platform in place or to remove it when the work is completed.

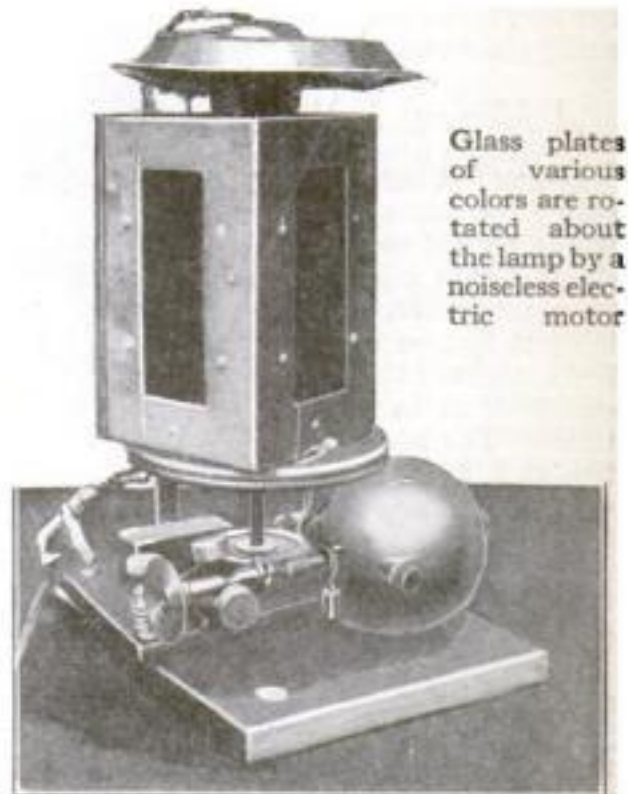
The inventor declares the device is as safe as a kitchen floor.



Single Lamp Varies Colors on Advertising Signs

TO PRODUCE changes in color in the illumination of advertising signs, an Indianapolis inventor has devised the electric lantern shown here.

Hitherto, color changes in illuminated signs were effected by the employment of many electric lamps of various colors. With this lantern, the effect is produced by revolving glass plates of different colors. These plates are rotated about a single lamp by means of an electric motor that is noiseless and self-lubricating and that requires no further attention once it is installed.



Glass plates of various colors are rotated about the lamp by a noiseless electric motor

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in Popular Science Monthly.

World's First Aerial Bicycle Flies

AN AERIAL bicycle, called the "cycleplane," driven only by foot-power applied by the pilot to an arrangement of pedals, recently achieved a short flight near Dayton, Ohio. It is said to be the first man-propelled flying device ever to lift itself from the ground.

This remarkable invention, the achievement of W. F. Gerhardt, aeronautical engineer at McCook Field, Dayton, Ohio, is 20 feet high and has seven tiers of wings, yet weighs only 98 pounds. It is admittedly crude in construction, being hastily built. Paper was used largely to cover the framework. The fuselage is torpedo-shaped and about 12 feet long.

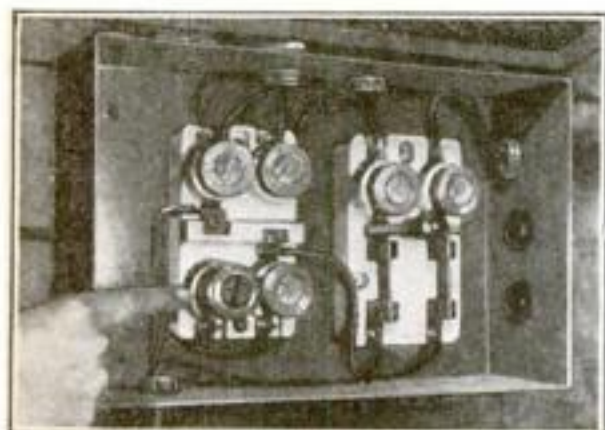
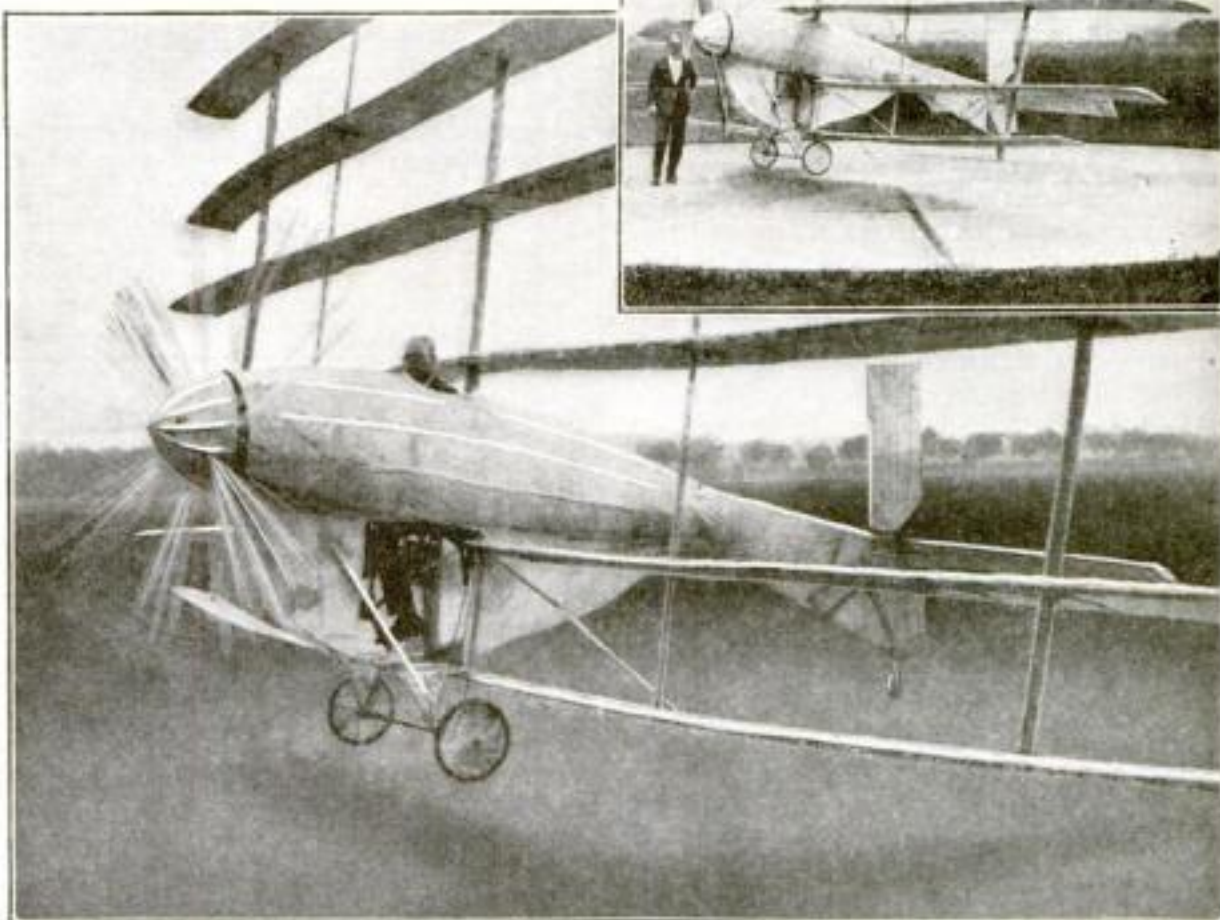
The pedals are connected with the propeller at the front by a shaft and gear arrangement. Complete control is centered in the "joystick," just in front of the pilot. It moves three ways, forward and backward to control the elevator and with a twisting movement to control the rudder.

In its test flight the machine traveled 20 feet and rose two feet from the ground.

The inventor is convinced that higher gearing, more careful construction and some modifications suggested by his trials will achieve a device capable of rising to comparatively great heights and attaining considerable speed. Future cycleplanes will be much smaller, he asserts.

Right: The 97-pound "bike" flying machine with which the inventor, W. F. Gerhardt, of Dayton, Ohio, recently made a short flight, using only foot power and pedals

Below: An instant in what is said to have been the first flight ever accomplished by a man-powered flying machine. The inventor served as pilot and motor



Six Fuses in One Socket

SIX fuses in the space commonly occupied by one is a recently devised convenience for the householder who forgets to keep a supply on hand. When one of the six fuses in the socket indicated by finger is blown out, a turn of the cap attached to it allows the current to pass through a new fuse.

The socket need not be removed.

A "Camera Filling Station"

THIS diminutive "camera filling station," built and displayed recently by C. L. Olds, of Lincoln, Neb., is made entirely of film spools except for four small nails holding together the roof signposts. Eight Christmas tree lights illuminated it in varied colors. A driveway of white crushed rock was used.



Built of spools and four nails

Ingenious Record Repeater Weighs Less than Ounce

A SIMPLE but ingenious phonograph record repeater, weighing less than one ounce, is a recent invention that makes home dancing without an orchestra more convenient and more enjoyable. It is said to be so simple that a child can attach it without difficulty or damage to the record or to the machine.

This device requires no adjusting. It merely is set in the center of the record,

This repeater does not touch playing surface



over the peg. It does not touch the playing surface of the record at any time, and its action is said to be so shockless and precise as not to endanger the record, needle, or tone arm. It is claimed that no appreciable pause intervenes between the end of the record and the start of the repetition.

As the needle reaches the end of the record, a movable arm, operating on a cam, picks up the tone arm and carries it, so quickly that the eye barely follows the movement, to the starting position. The arm is then returned to its place by a coil-spring. The length of your dance records now is measured by the capacity of your phonograph spring.



A Permanent or Temporary Paper Fastener

BUSINESS papers may be fastened together permanently or temporarily for working purposes by means of this improved fastener. The machine is adjusted simply by turning a little device with the forefinger; when one side of this device is turned up, the staple is pushed through the papers and clinched. When the other side is up, a temporary fastening is made.

Wood of Sawdust and Chalk

USING a mixture of 50 per cent sawdust with chalk and chemicals and subjecting it to extremely heavy pressure, a Norwegian inventor claims to have perfected an artificial wood possessing the toughness of real lumber.

The new substance is said to have the hardness of oak. It can be planed, sawed, bored, painted, and polished.

Our Silent Partners, the Plants

"The Story of Man and His World"

By E. E. Free, Ph.D., and D. T. MacDougal, Ph.D., LL.D.

EVERY human being is a parasite. Whether we like it or not, we must live upon the labor of others. These others are the plants.

Plants supply all the food in the world. They can support themselves by absorbing non-living substances like water, salts from the soil, and gases from the air. We animals cannot do this. We must have more complicated foods, things like fruits or tubers or the bodies of plants, substances like starch or sugar that plants have manufactured, or the flesh of other animals who themselves have lived, in the last analysis, on vegetable products.

If all the animals in the world were wiped out by some cosmic cataclysm, life would still go on. Plants would remain and animal life undoubtedly could be developed again. But if all the plants died, life would disappear. We animals, deprived of the plant hosts on which we feed, would soon starve and the world would be as lifeless as in the beginning.

One Common Ancestor

Both plants and animals are descended, as we saw in the first chapter of this series, from the same creatures, from those little living slime specks on the ancient seashore, which were, we believe, the first form of life on earth. This was perhaps a billion years ago or more. Soon the specks diverged, you remember, into two groups. Some of them learned how to move themselves about and these became the ancestors of animals. Others learned how to make food for themselves out of non-living chemicals in the water, and these became the ancestors of plants. This marked the separation of the two great branches of the tree of life—the animal branch and the plant branch.

The later history of the animal branch we have already traced. We have seen how the descendants of the moving slime specks grew more and more complicated in form and bodily character, how they invented in turn the backbone and legs and warm blood and lungs to breathe with, and all the thousands of inventions that make up that culminating product of animal evolution—the body of man.

Meanwhile the plant branch has been inventive also. Plants have invented leaves, for instance, and strong stems like the trunks of trees, roots to take up water and food materials from the soil, fruits and seeds and flowers, all the thousands of bodily devices that modern plants possess.

The greatest of plant inventions was the first—how to make food of non-living materials. The secret was the use of the

IN THIS article, the eighth in POPULAR SCIENCE MONTHLY's fascinating series on Evolution, Doctor Free, Fellow of the American Association for the Advancement of Science, carries us one gigantic step farther in his thrilling story of Nature's growth. This month the author has collaborated with Doctor MacDougal, well known for his valuable scientific work. Doctor MacDougal is Director of the Department of Botanical Research of the Carnegie Institution of Washington.

energy of sunlight. There still live in the sea vast numbers of tiny floating plants, billions of them in a bucketful of water, that still make food in about the same way, prob-

ably, as it was made by their first ancestors.

These plants contain a green substance, the same that gives the green color to all plants. This substance is able to take up some of the rays of sunlight and to use the energy from them to run its food-making machinery, just as a man-made factory uses electrical energy.

Sunlight furnishes, then, the power for the plant food factory. The raw materials come from the water. One of them is water itself, the other is a chemical compound called carbon dioxide. This compound is really a gas, the same gas that makes the bubbles in soda water. There is always a little of this carbon dioxide gas dissolved in sea water and this is taken out by the plant. It and water are built up chemically, by the energy of sunlight, into a simple kind of sugar, that is, into food.

Plants that have come ashore and learned to live in air still make food in this same way.

Every Garden a Sugar Mill

There is a little carbon dioxide gas in air too, and the leaves take up some of it. There is water, too, inside the leaves. This gives the leaf the two necessary raw materials and sunlight provides the power, just as it always has. So the leaf makes sugar out of water and carbon dioxide and sunlight. This feeds the whole plant. Indirectly it feeds us. The process of sugar making is called photosynthesis. It is one of the oldest inventions of living matter and undoubtedly the most important.



Courtesy of Nature Magazine, Washington, D. C.

Trapped by the Milkweed

THE remarkable photograph above, highly enlarged, shows how the flower of the common milkweed catches and holds a cluster fly that has visited it in search of honey. The struggles of the insect cause pollen to stick to its legs. If the insect is strong enough to escape, this pollen is carried off to fertilize another flower.

A cluster of milkweed blossoms like the one above is shown in life size in the right-hand picture



The next important invention in the line of plant evolution was that of a resistant body that could not easily be pulled apart. Before this, some of the single plant specks had taken to living together in groups, just as the animal specks had, and had produced thus the first many-celled plants. In the beginning, these aggregates of living cells were stuck together loosely, we may suppose, as the cells of some living water plants still are. Gradually the union between the cells became more permanent. The individual cells developed outer walls of a tough skin-like substance that we call cellulose. Some of them grew long and thin like threads, so that their tough walls held the mass of living cells together. These elongated cells gave the plant strength so that the movement of the water in currents or with the tide would not tear the body of the plant apart.

Just as the animals developed muscles and bones in order to move where they wanted to in spite of the currents, so the plants developed these threadlike cells so that they could sit still and not be torn apart when the water moved.

Most plants still have these thread cells. They hold together the long fronds of seaweed. They are the fibers that stiffen the wood of trees, fibers that we take out and make into paper. The fibers in the flax plant give us linen thread and those in the hemp make rope for us. Similar elongated cells in the seed pod of the plant make the fibers of the cotton.

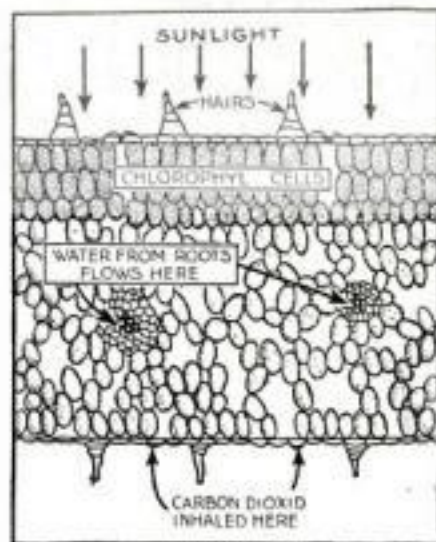
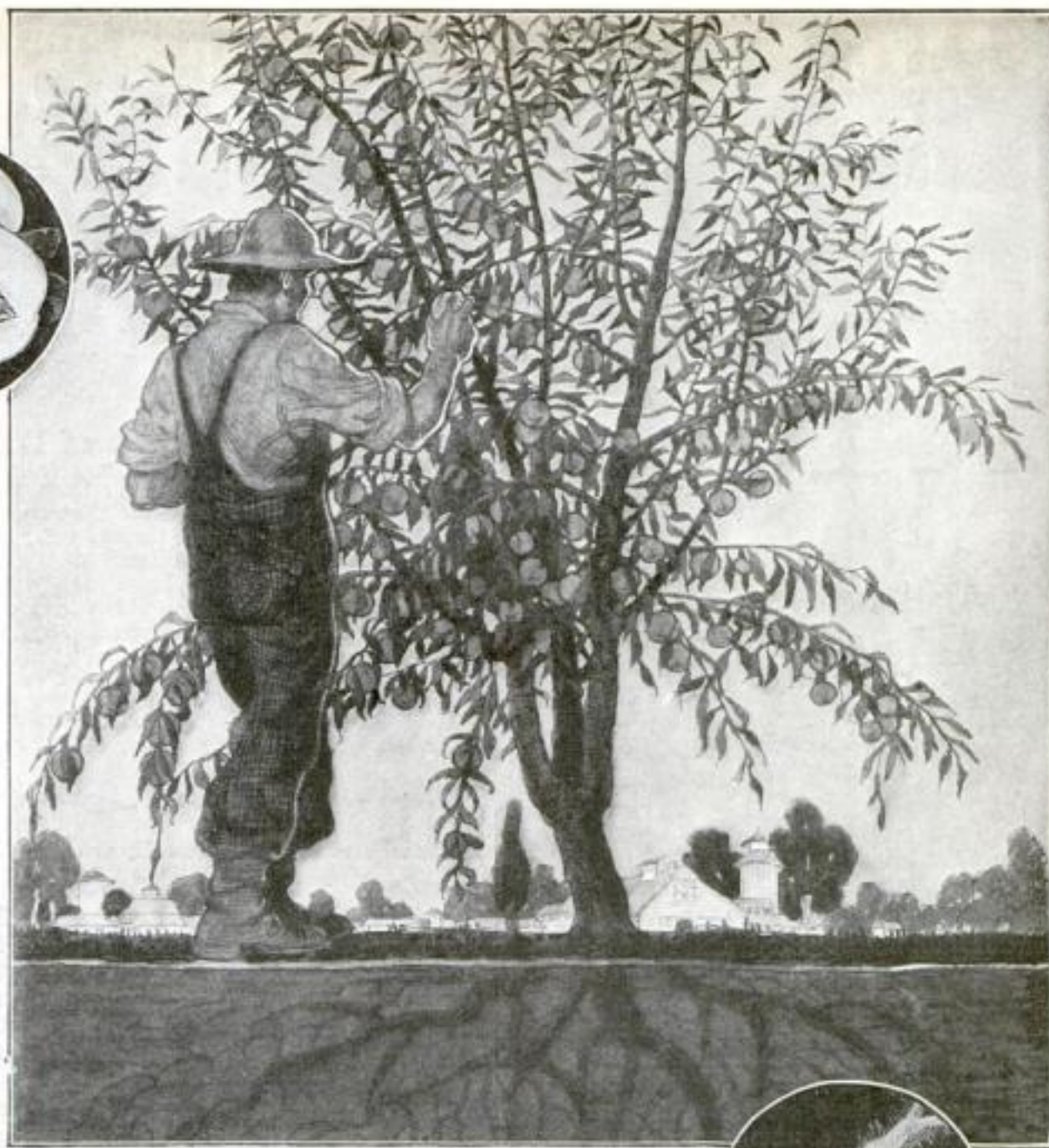
These three plant inventions were made while plants lived only in the sea. The land, as yet, was bare. But the sea was growing crowded. Food was scarce in it and there was a strong incentive for animals and plants alike to move out onto the shore.

This required, however, fundamental modifications of the body. To a living plant in the ocean the water and the carbon dioxide that it needed for food came to it automatically in the water that bathed it. In the air all this would be changed. New devices must be perfected to meet these changed conditions.

The plant inventors had to go to work again.

The advance of the plant army outward from the sea was slow and tentative. The oldest land plants that we know have been found, as fossils, in the rocks of Scotland. They are probably about 400,000,000 years old. Apparently they were shaped a good deal like the seaweeds from which we believe them to have sprung. Instead of true roots they had merely a bulbous enlargement buried in the soil, somewhat like the root of a present-day mushroom. They had no true leaves, only some rounded stems, that probably were green in color, that may have resembled superficially the stalks of asparagus you buy nowadays in the market.

These very ancient land plants had already made, however, two important inventions. They had invented a protective covering, or skin, so that they would not dry out in the air as a seaweed would. They had devised, also, a



Plant Inventions

(As shown by the peach tree)

THE many leaves and branches expose the greatest possible surface to the air and sunlight. The widespread root system makes the water from the soil readily available. Seeds are the means used by the tree to propagate its kind, wrapped in a tempting fruit that is carried away by man and animals to other parts and eaten, after which the seed is dropped and later becomes a tree. At left: Cross section of a plant leaf, showing how the green substance, chlorophyll, manufactures sugar in living plants by absorbing sunlight and combining carbon dioxide and water



Millions of tiny root hair: absorb water and food from the soil.

root of the first land plants developed projections and branches, and these grew millions of little hairlike threads hanging on them, so that the plant had a root system,

a stiff stem structure, built, as usual, out of elongated fiber cells, so that they could hold their stems upright and thus get more light for use in the manufacture of food.

In the next fifty or a hundred million years these two inventions developed into practically the modern form of plants—the familiar structure of leaves, branches, and main stem. The utility of this structure is that it exposes as much surface as possible to the air and to light, both of which are necessary for the manufacture of food.

At the same time the original bulblike

stem, a very large surface, available in the soil through which surface the plant could absorb the water that was no longer provided directly at the surface of the leaves. The impervious skin that was necessary to keep the plant from drying out developed many little microscopic holes, called stomata, through which the gases of the air could penetrate and provide the necessary carbon dioxide gas to the food-making machinery inside.

In the stems and branches there developed long tubes through which the water from the soil could rise (as what we call sap) to the place where it was needed in the leaves. All these changes were devices to expose the leaves (where food was made) to as much light as possible and to provide them with the two necessary raw materials—water and carbon dioxide gas.

It is interesting, in passing, to compare the way in which the animals met this same problem.

Flower in the crannied wall,
I pluck you out of the crannies,
I hold you here, root and all, in my hand,
Little flower—but if I could understand
What you are, root and all, and all in all,
I should know what God and man is.

—Tennyson.



Nature's Unending Cycle of Food

ALL green plants manufacture sugar from the water, carbon dioxide gas, and sunlight that they absorb. Animals then eat the plants, and they in turn die or are killed and eaten by man, who himself dies, and whose body then, in common with all plants and animals, sets free water and carbon dioxide gas, which brings us once more to the beginning of the eternal cycle



Water and carbon dioxide continually are being built into bodies of living creatures and set free

They, too, developed skins that would prevent drying, but they provided for the gas they need, namely, oxygen, by the device of inclosing in their bodies a little sea water, which became blood. Plants increased their surface (by branches and leaves) so that nearly all the matter of their bodies could come in close contact with the air itself. The animals, with some exceptions like the insects and the earthworms, provided for the forced circulation throughout the body of a fluid blood artificially charged in a special organ, the lungs, with the needed gases of the air.

Life's Marvelous Adjustments

Every creature, plant or animal, that lives on the land and breathes the air is living, really, under conditions to which it is unsuited and in surroundings for which it was not designed. We air-breathers manage to live at all only because of the astonishing inventive genius of life, just as men can live in the Arctic by the artificial expedient of heated houses, or down under the sea in invented submarines.

How successfully the plants managed to live on land and how long ago they did it, is indicated by the fact that about 300,000,000 years ago most of the earth was covered with luxuriant vegetation, the vegetation that produced our coal beds. There were few land animals then. Some insects existed and a few sluggish, crawling amphibians, half reptile, half fish. The land world in those days was a world of plants. Most of the animal life was still in the sea.

But at the end of the coal period the world fell, it seems, upon times of climatic disturbance. The weather, which had been warm and equable all over the earth, became variable. Some countries grew cold, others hot. The seasons, which had been much alike, became sharply different.

There were profound effects, of course, on the forms of life. The plants which had conquered successfully the difficulties of coming ashore had another ordeal to face. How were they to survive the dryness of

a long and rainless summer? How could they escape being killed by the winter cold?

They met these difficulties in different ways; but the most successful solution, on the whole, was the invention of the seed. All the seed is, really, is a device to keep the plant alive during an unfavorable season, or, what is the same thing, to start a new plant of the same kind when conditions for life become more favorable.

Certain kinds of plants a good deal like modern ferns had already fallen into a habit of what is called the alternation of generations. One generation of such plants was quite different in appearance from the next one. The first generation, for instance, might be a small creeping weed that lived only a few days; the generation that grew from this weed might be a great tree that lived for many years. The third generation, in turn, would be like the first, and so on.

Out of this habit developed the device of seeds. One of the generations, usually the smaller one of the two, came to live its life, not freely, but as a parasite on the other generation. Then this parasitic plantlet, really the dwindling remnant of the alternative generation, became inclosed in a sort of a case or coat and did not

live in the open at all. That is, it became a seed.

If you carefully cut open a bean or pea seed, or any seed, for that matter, that is large enough so that you can see what is inside it, you will notice that it contains a little whitish thing that is really a tiny plant.

When the seed sprouts, it is this little plant that comes out and grows. Most seeds contain, also, some food to provide for this plantlet until it can grow large enough to feed itself. This food is the starchy or oily or "meaty" part of the seed. Cornmeal, for instance, is the food that was stored up in the seeds for the little plants. The plants themselves are the "germs" that the miller takes out and throws away.

Plants Die; Seeds Replace Them

When the cold winters of the years following the coal period clamped down their ice and snow on the land, the large plants died.

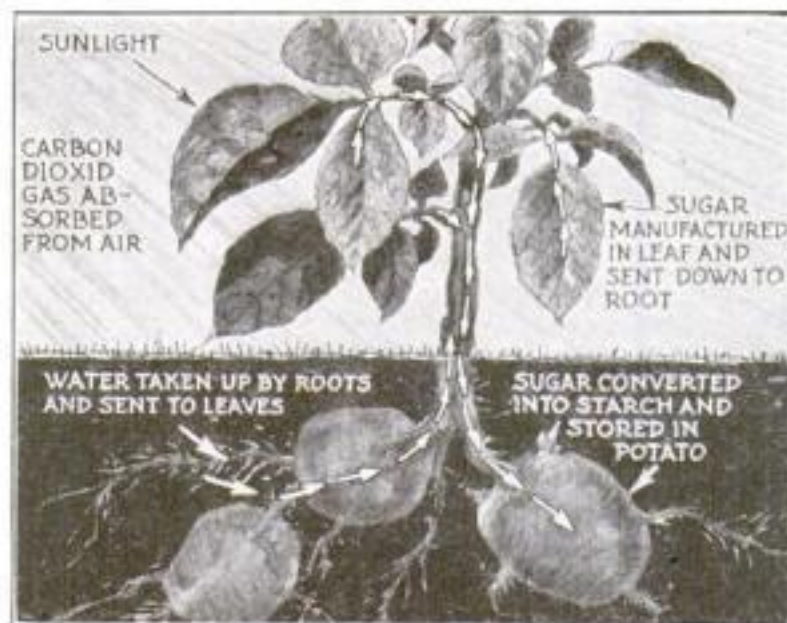
But these plants had left seeds behind them. The seeds could stand the cold. In the spring they were still alive, and as soon as the weather was warm enough, they woke up and started all over again.

The animals, of course, had to meet this same problem of surviving the winter. Some did so by developing the habit of hibernation or winter sleep, a habit which the ancestors of our frogs acquired at this time and which their descendants still possess. Another group of animals—the insects—met the problem in exactly the same way as the plants did, namely by making use of an alternation of generations. This is what the yearly change of grub to butterfly and butterfly to grub really is and this is why it was developed.

But this is not quite all of the story. It is never enough for life, it seems, merely to survive. It must expand, enter new realms, conquer more territory, just as plants and animals advanced out of the sea.

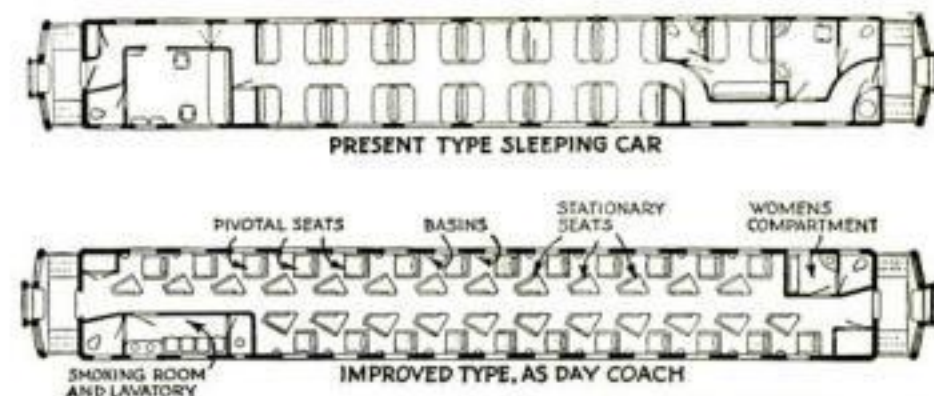
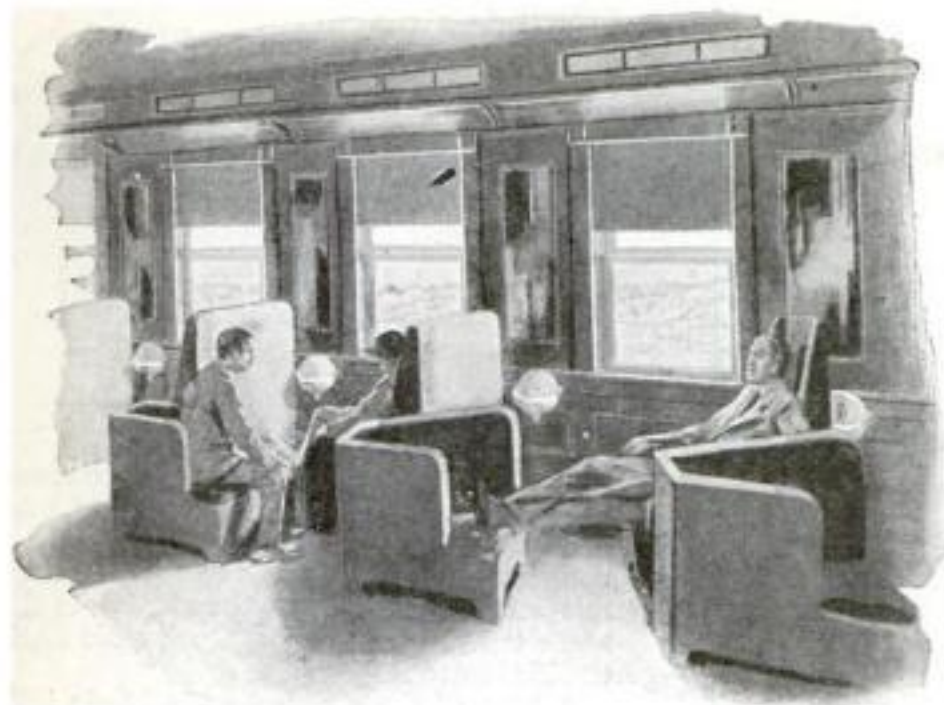
Now the plants, you notice, have handicaps against expansion on the

(Turn to page 118)



How Nature makes potatoes. The sugar manufactured in the leaves is transported downward into the tubers and there converted into starch for storage

A Lower Berth for Everybody, Is New Plan



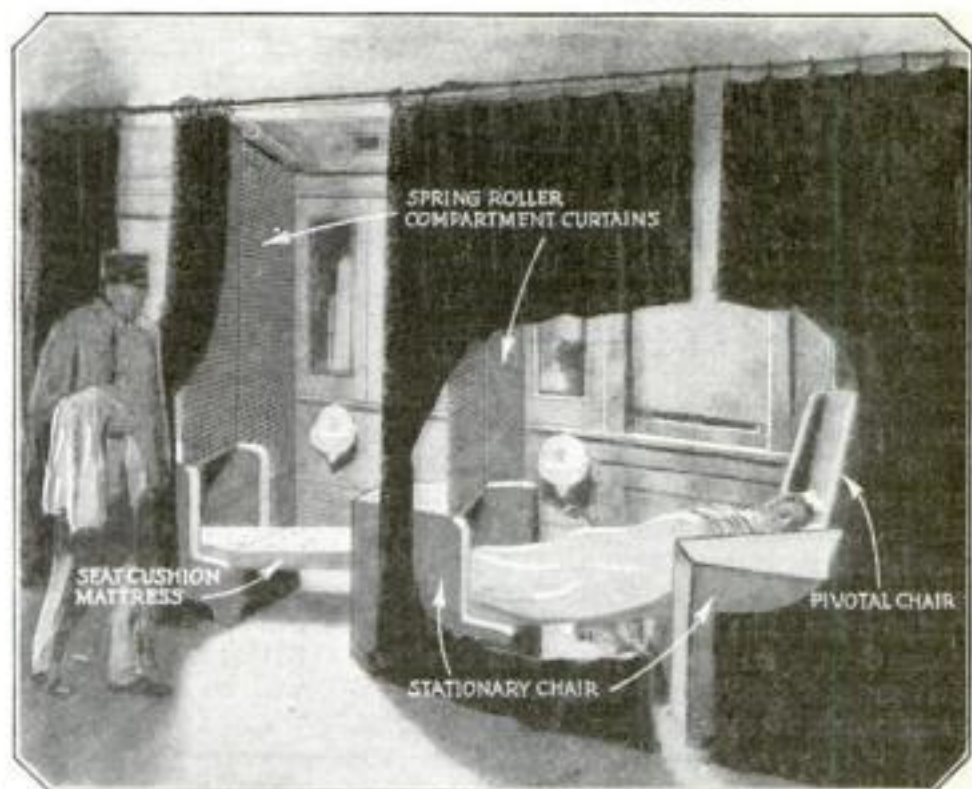
Above: Diagram contrasting the daytime arrangements of the old and new sleeping-car designs. Right: How the new type seats are converted into beds



SPACIOUSNESS and comfort, both day and night, are provided in an ingenious new design for sleeping cars proposed by M. C. Krarup, consulting engineer. The illustration above shows two compartments of the car arranged for daytime use. The seat nearer the window is pivoted, allowing a range of positions. The fixed aisle seats double the day accommodations of the car. Twenty-four of these compartments can be contained in an ordinary sleeping car.

AT THE right: The same two compartments converted into sleeping berths. Note the spaciousness, allowing comfortable headroom, a personal wash basin and a large mirror. Bedding is stored in the lower portions of the chairs, and the mattress is produced by lowering the back cushion and extending the seat of the pivotal chair.

The compartments would be separated by partitions of material such as bakelite paper, which is stout and yet can be pulled down from oblique spring rollers in the ceiling. Two would be required for each compartment, one attaching to the pivotal chair and the other, slightly overlapping the first, hooked across the stationary aisle seat. The projecting portion of the aisle seat would be covered. The aisle curtains would resemble the usual drapes now used in sleeping cars.



This Coin-in-the-Slot Radio Is Parisian Innovation

THE penny-in-the-slot machines with ear tubes that had their habitat in depots, amusement parks, and hotel lobbies have, for the most part, disappeared.

With them have vanished the songs they emitted in squeaky jumbles of sound. But the idea they embodied lives today in this French radio machine, which is invading wherever Parisian crowds are.

In cafés, motion-picture theaters, hotel vestibules, steamship cabins, and many other public places, this coin-in-the-slot receiving apparatus is plucking melody from the ether and coins from the purse.

The coin connects the receiving apparatus for a limited time. A card beside the device tells the hours when music is available.

Revolving Sash Facilitates Window Cleaning

WINDOWS with double-hung sashes, that not only can be raised and lowered in the usual manner, but also swing completely around on horizontal pivots, have been designed recently to facilitate cleaning. When tilted at right angles to

their normal positions, the entire window space can be used for ventilation. The windows are made for any size of opening and may be installed in any house, old or new.

Tilting them at an angle assures draft-proof ventilation even on windy days.

Crimped Shingles Restored By U. S. Forestry Service



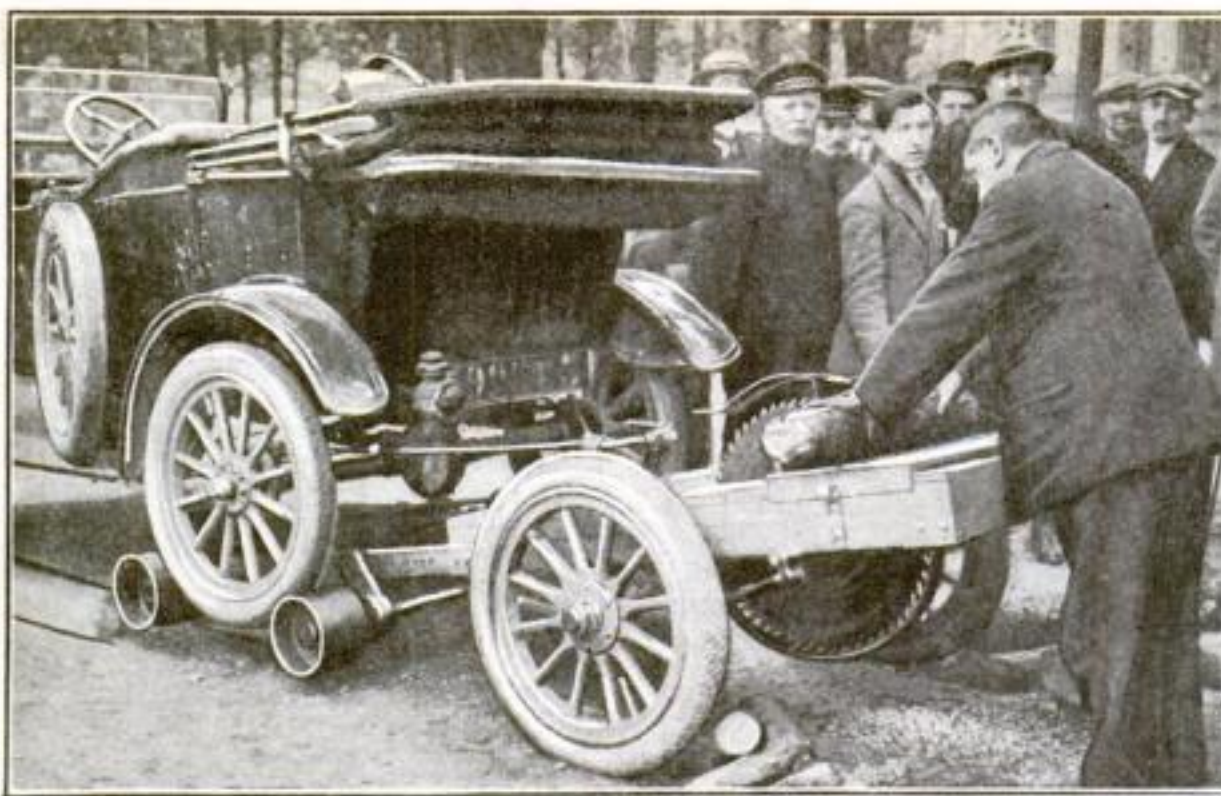
Cedar shingles before and after undergoing the new process

A METHOD whereby shingles of cedar and similar wood that have crimped in drying because of excessive moisture may be restored, has been announced by the United States Forestry Service. Since shingles thus damaged are worthless, the discovery promises some really valuable economies.

Crimping is due, it was found, to the collapse of the wood cells that contained the free water. If the shingles are subjected to live steam at boiler pressure for 20 hours and then dried in a kiln at a temperature of 160 degrees, with from 25 to 35 per cent humidity, the crimp disappears.



Safe, easy cleaning with swivel sashes



Auto Engine Serves as a Sawmill

THE "How My Car Serves Me" prize contest, announced in the September issue of *POPULAR SCIENCE MONTHLY*, has met with immediate response from our readers who own automobiles. Many of them have sent in letters and photographs describing novel uses to which they have put their cars.

All the way from Paris, France, comes an interesting contribution, an invention of M. G. Schoedlin. The photograph of his ingenious motor-car sawmill is reproduced above. With this saw, mounted on an inclined truck at the rear of the car, he has more than paid for his car. The device is driven by the two rear wheels of the automobile which rest on two friction rollers.

When the engine is started, the saw revolves with sufficient force to cut logs of the size ordinarily used for firewood.

Competition in the "How My Car Serves Me" contest closes September 20. For the best letter of not more than 400 words, accompanied by photographs or drawings, we offer these prizes: \$20, first prize; \$10, second prize; \$5, third prize. A number of the contributions will be published next month. Prize-winning letters will appear in the January issue.

Address Automobile Contest Editor, *POPULAR SCIENCE MONTHLY*, 225 West 39th Street, New York City. Each letter will be considered by a board of editors, whose decision will be final.



© Keystone

Baby Is Given Fresh Air in Window Cage

BABIES of flat and tenement dwellers, whose tiny lungs have been forced to breathe stale and overheated air, are offered relief by the recent English invention pictured above. A large metal crate is attached to the outside of the window by two stout iron poles. A baby basket can easily be lowered inside. If insects are likely to trouble the child, the crate can be screened.

Droplights Are Adjusted by Simple Arm Device

DROPLIGHTS that swing from the ceiling by flexible wires have always been difficult to adjust to heights and angles such that they throw a maximum amount of light on the proper spot. Any one who has used them in the study, the office, the workshop or the garage has probably been forced to change the height by knotting the cord and to swing the lamp from place to place by tying it with strings attached to walls, joists, desk legs and other places.

A St. Louis man has devised this simple attachment, which permits the droplight to be adjusted as desired. It is a pivoted arm to which the light may be fastened at any point. Swinging the arm up or down or from side to side causes rays to fall wherever desired. A movable clamp permits the arm to be placed wherever necessary.



The light adjuster aids in typesetting

Quick-Change Screwdriver Contains Three Blades

THE ingenious little tool shown here is called a "lightning-change magazine screwdriver." It has three sizes of blades, contained inside the handle and numbered 1, 2, and 3, according to size. There are three corresponding numbers on the handle, and the blade desired is obtained for use by turning a cap, rotating the handle until the number corresponding to the number of the blade is up, then tipping the handle until the blade drops into place.



A turn of the cap locks the blade into the handle for use and holds it rigid. The blade springs back into the handle when the locking cap is turned in the opposite direction.

These Two-Piece Overalls Are Dustproof



This dust-proof overall suit, consisting of jacket and trousers, is said to offer unusual freedom of movement

THIS work garment has all the appearance of the ordinary one-piece overall suit, but in reality it is a two-piece suit so fashioned as to be absolutely dustproof.

The suit consists of a jacket and trousers. The jacket has a waistband under which are tabs which button to the trousers. If the trousers wear out or are hopelessly torn, it is not necessary to discard the entire garment, as would be the case with the ordinary one-piece overall. It would be necessary merely to buy new trousers.

The garment when fastened together may be put on and taken off as a one-piece suit, and when buttoned it is dustproof. It has no bibs, strings, double folds, buckles or catches to bulge and dangle, thus permitting greater freedom of action and making laundering easier.

Making Shoal Water Soundings with Light

AN ENGLISH inventor has devised a method of utilizing projected light to determine the depth of water through which a vessel is passing. The device is said to supply an accurate and satisfactory substitute for the time-worn operation of "heaving the lead" to make soundings in shallow water.

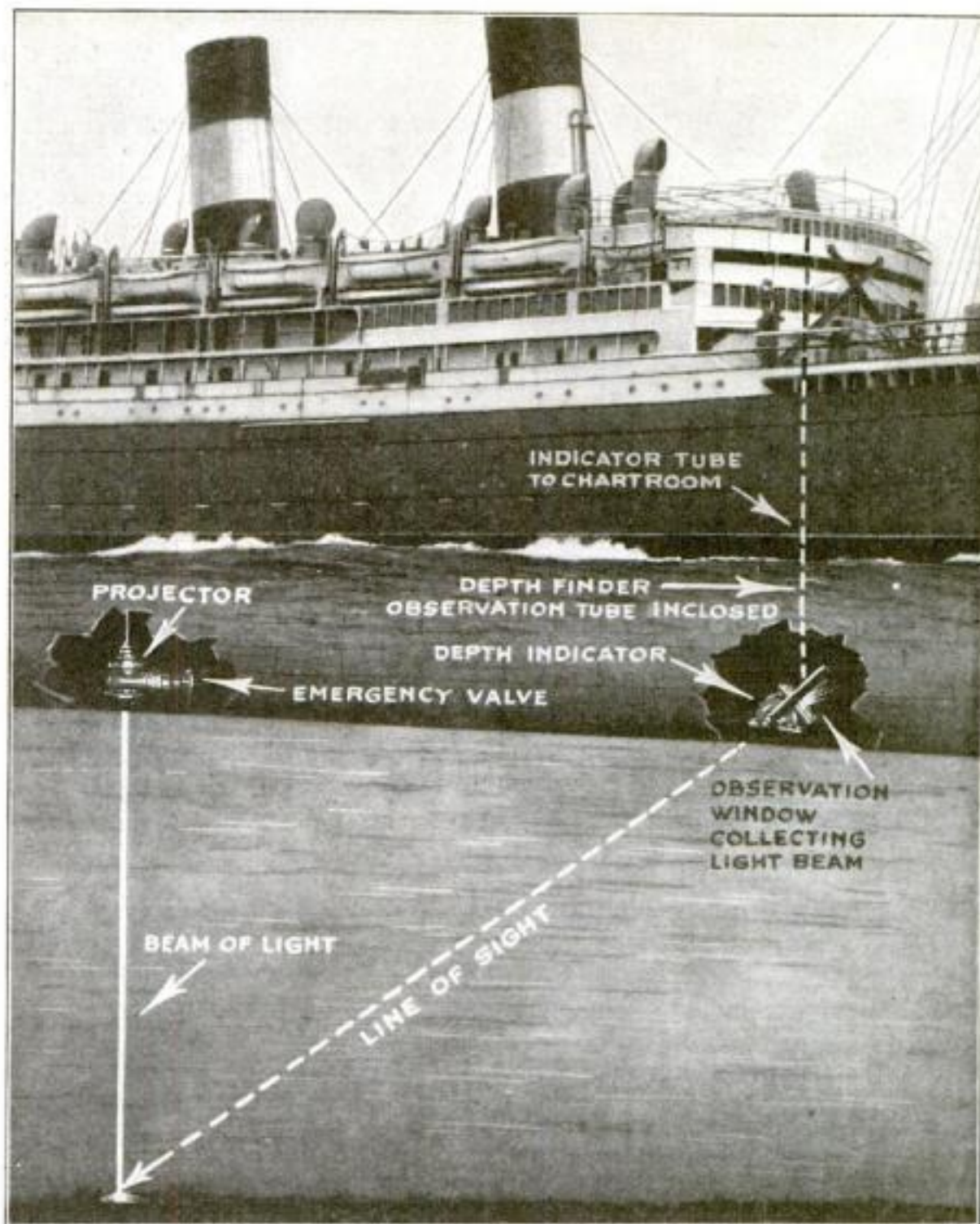
The apparatus consists of two parts. One of these is a projector, which, through a porthole in the bottom of the hull, throws a beam of light directly downward to the bed of the waters. The other part, called the "depth finder," is placed at another porthole some distance from the first in the bottom of the vessel in such a position that the beam of light may be observed plainly. In this manner the angle between the line of the beam and the observer's line of vision is recorded accurately.

How Depth Is Determined

Running perpendicularly from the chart-room is a tube connected with the depth finder. By an arrangement of mirrors the ray of light is reflected through this tube so that it can be observed continuously by the navigating officer. After the apparatus has recorded the angle between the light beam and the line of observation, a simple calculation determines the depth of water beneath the vessel with absolute accuracy.

The apparatus, of course, cannot be used in sounding the depths of the ocean, for it is impossible to project a ray of light powerful enough to penetrate to the bottom. But it is entirely efficient in rivers, and other shoal waters where frequent soundings are necessary to a vessel's safety.

Soundings can be taken with this instrument under any weather conditions and at any speed. The necessity for "slowing down," as with the prevailing method, is obviated. The only instance in which it could not be used would be in the rare event of the failure of the electric current.



How beam of light, projected downward, makes soundings. Depth is determined by mathematical calculations based on the angle formed by light beam and line of light



Chicken Incubator Used in Cheesemaking

AN ORDINARY chicken incubator has been used with striking success to test milk in cheesemaking by J. L. Sammis, of the Wisconsin College of Agriculture, shown above with his testing apparatus.

Milk samples are placed in test tubes in the incubator and subjected to heat of a temperature favorable to the development of bacteria. The samples are tested, and the milk is accepted or rejected, according to its reaction to the heat.

Gyroscopic Indicator Makes Night Flying Safe

PERILS of flying by night, or in clouds have been lessened by a new gyroscopic indicating instrument recently perfected by the United States Army Air Service at McCook Field, Ohio. It consists of two gyroscopes with axes at right angles to each other, and a glass tube resembling the bulb of a carpenter's level.

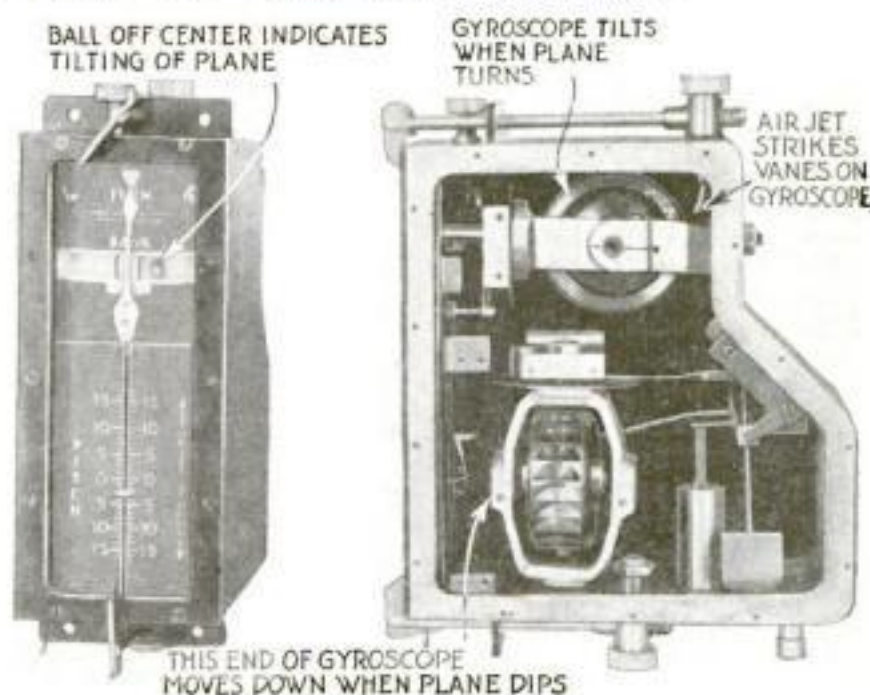
The turn-indicating gyroscope has its axis horizontal and parallel with the wings. A turning of the plane to the right causes the top of the rotating gyro to tip to the right, actuating a pointer that shows the amount which the plane has turned.

The pitch-indicating gyroscope also is mounted on a horizontal axis at right angles to the first. A downward pitch of the plane causes the registering end of the axis to move down, and the pointer shows on a scale the amount of dip at which the plane is descending.

When the plane is moving horizontally, all scales

read zero, but as soon as one wing drops lower than the other, the ball within the gage glass moves to one side.

Both gyroscopes are turned by a jet of air that is shot against vanes formed in the rims of the wheels. This jet of air is produced by the suction of the wind.



On the face of the indicator (at left) pointers register turn and pitch, while a level indicates tilting of plane. At the right, interior of the device, showing the two gyroscopes

Roof Railway Aids in Cornice Work



At the left, the roof railway, showing handcar with counterweight and balanced ladder suspended over the edge of the building. Below, the moving ladder and platform from which workmen replace lights on the cornice

TO FACILITATE the work of changing electric lamps for the cornice lights of its building, the *Seattle Times*, of Seattle, Wash., has installed a small railroad on its roof. The *Times* found that the many cornice lamps illuminating the building were difficult to replace, sometimes requiring 10 hours of labor. Other problems of work about the roof also were troublesome, and as a result the railway was decided upon.

Steel tracks were laid on the roof, running all around the edge. On these tracks a three-wheeled hand car is operated. On the inner side the car carries a 200-pound counterweight. The outer side supports a ladder designed to hang over the edge of the roof. At the bottom of this ladder is suspended a small railed platform on which the workman rides.

Standing on this platform the worker moves quickly from lamp to lamp, while helpers push the car along the track. Instead of the 10 hours formerly required to change the lights, the work is now done in two hours.

The amount of work saved and the



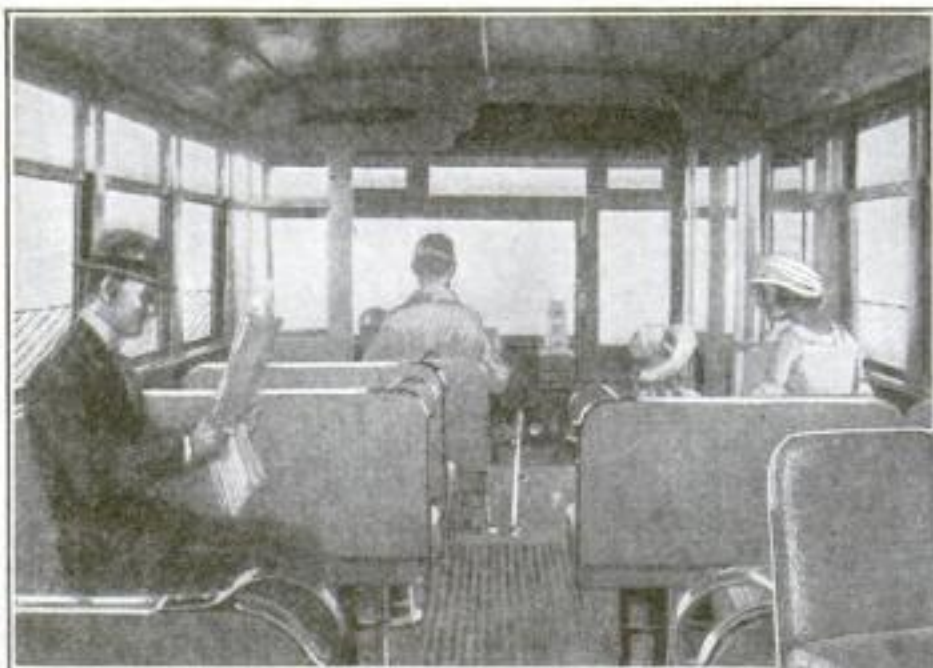
greater comfort and safety of the workman can be realized from the fact that formerly attention to the cornice lights meant 110 trips over the side of the building on a small ladder.

Air Cushion Seats Designed for Motor Buses

OMNIBUSES with seats that rest on pneumatic shock absorbers promise to solve one of today's greatest passenger transportation problems in rural and suburban districts. Country roads are not always in first class condition, and to protect the passengers from painful bumps and shakings it is necessary to use pneumatic tires on the wheels of a vehicle. But such tires are costly and, owing to the bad condition of the roads, have a brief life.

A new type of seat, recently placed on the market, makes it possible to employ solid tires without exposing passengers to the discomfort of shocks, and perhaps injury, when traveling over rough roads. According to the width of the seats, they rest upon one or two valve-controlled pneumatic shock absorbers acting through springs. The cushions consist of two telescoping

metal cylinders, carefully machined so that they fit practically airtight when lubricated. They are said to be so efficient that passengers may read without undue eye strain.



Interior of new easy riding omnibus with seats equipped with pneumatic shock absorbers, as shown at the right. An air cushion enclosing a spring absorbs the jolts over rough roads



Spurned Corncob Rises to Dignity of Wood

YOU, who have thought of corncobs only as holders provided by Nature from which you might nibble the sweet kernels, should be interested in the recent discovery by Professor Darling, of Milliken University, Decatur, Ill., of a process by which 60 per cent of the cob can be manufactured into a substitute for wood. Professor Darling is shown above in his laboratory, making his synthetic wood.

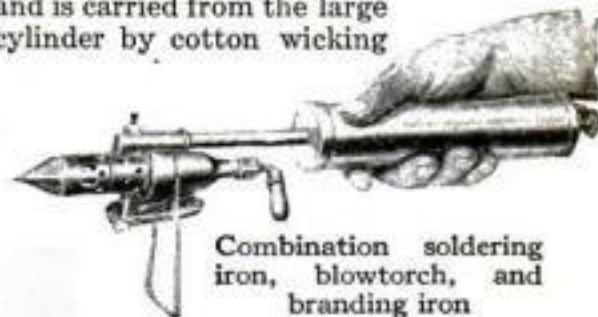
The cob is ground to a flakey, fibrous pulp and, after being mixed with a suitable binder, is compressed by a powerful hydraulic press.

The finished product can be whittled, glued, nailed, screwed, shaved, or turned on a lathe without danger of chipping. It will withstand a pressure of 10,000 pounds to the square inch. It can be stained and varnished like ordinary wood.

A Blowtorch that Solders and Brands

A COMBINATION soldering iron, blowtorch, and branding iron, which is self-heating, of light weight, and little more than a foot in length over all, has been developed by an Illinois manufacturer.

Gasoline is used as fuel, and is carried from the large cylinder by cotton wicking



Combination soldering iron, blowtorch, and branding iron

to the flame tube through which it is fed by a patented needle valve and vaporized.

A special alloy steel tube connects the fuel tank with the burner in order to keep the tank cool at all times.

The device may be adapted to any of its three uses by a simple adjustment. The fuel feeding is said to be so arranged as to insure safety to the user.

Handwriting Telegraphed

TELEGRAPHIC transmission of written script—1453 words in six minutes—was accomplished recently by a new French invention. The handwriting was sent from Lyons to Malmaison, near Paris. Ordinary transmission of such a message by telegraph would have required 25 minutes. The promoters of the new device plan to make it available soon for the use of the French public.



Bicycle Searchlight Made with a Flashlight

A BRACKET that permits an ordinary pocket flashlight to be utilized as a searchlight by a bicyclist has been invented by Clarence E. Graves, of Hammond, Ind. It is a strip of sheet metal fitting the circumference of the flash lamp, to which it is secured by a bolt and thumb nut. It is fastened to the handlebar by one of the bolts that engage the bar at the head of the bicycle.

Adjustable Window Shelf for Flower Pots

FLOWER lovers who are city dwellers will warm to "Betsy Bobbit." The young lady is an attractive adjustable shelf, which makes it possible to have a

flower pot on even the narrowest windowsill.

The device is of metal, sturdily built, and capable of supporting a pot weighing 20 pounds. It hooks over the sill, between the sash and the sill, and does not interfere with raising or lowering the window. The retaining strip gives the strength necessary to support pots heavier than 12 pounds. It is fastened to the apron or facing of the win-



dow by a few tacks and the slanting piece then is engaged in it.

The invention is easily slipped into place, and its inner support, made attractive by a hand-painted picture of an old-fashioned girl, lends itself well to any home interior.

Gracing bare windows with flowers gives charm to the dingiest and least inviting of exteriors. And flowers in windows, never sun-hungry, always thrive.

Nerve Splicing Is Achieved

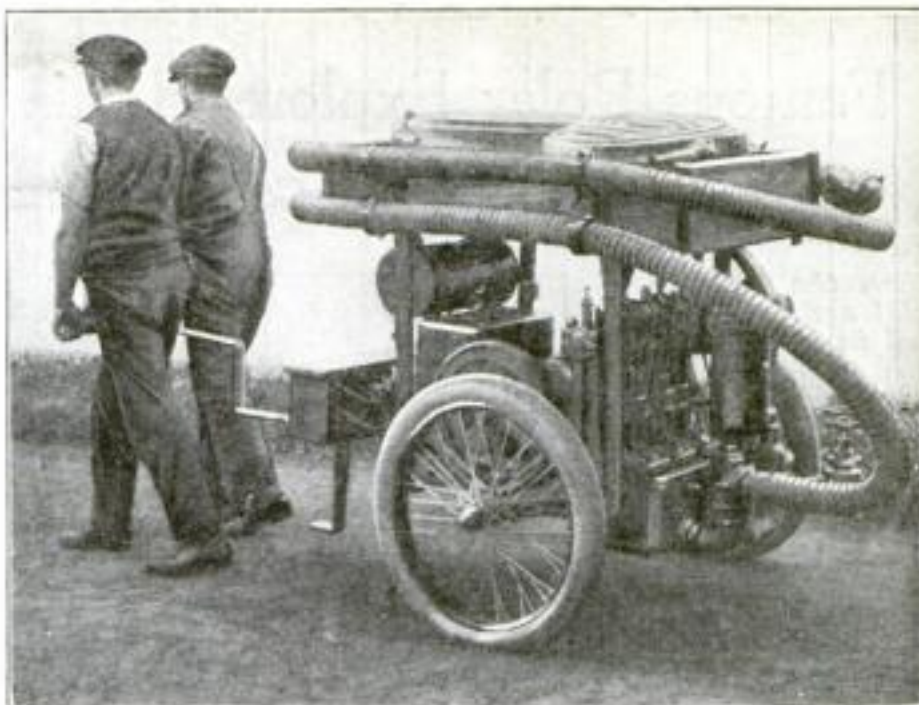
NERVE splicing, said to be the most delicate of surgical operations, is one of the latest achievements of curative science. Nerves from animals may be used to restore health and activity to human muscles and other body parts suffering from nerve loss or disease.

A Mobile New Pump with Many Uses

AN ENGINE-DRIVEN double-cylinder pump, mounted on automobile wheels, so that it may be moved from place to place by automobile, motorcycle, or motor truck, or drawn by hand, has been perfected by a Pennsylvania manufacturer. The device is said to adapt itself to a variety of uses.

It may be used for any purpose for which a pump is necessary, in construction work, in repair work, or in irrigation. Its mobility adapts it for general pumping utility about a farm or industrial plant. It is, moreover, a particularly effective piece of fire-fighting apparatus. Industrial plants and small towns could find inexpensive fire protection in it.

The engine develops five horsepower, and the double cylinder assures a continuous stream. This stream can attain to 80 gallons a minute. A single, half-inch stream may be directed from a half-inch



This easily transported pump, with its capacity of 80 gallons a minute, can fight fires or empty flooded basements

fire nozzle on a blaze at a considerable distance. For fires closer to the machine, two high-pressure streams may be used. The suction hose is adapted for quick and convenient use in lake, creek, well or in any flooded place.

The pump and engine are securely mounted on steel, thus permitting the device to be safely transported at high speed over rough roads. The apparatus weighs 1300 pounds, completely equipped.

Inventor Soars in a Ten-Pound Flying Device

INVENTING a 10-pound flying machine and then flying with it was the daring exploit performed recently by a German inventor, Dr. I. Seehaase, who is shown

here with his folded diminutive gravity-outwitter over his shoulder. The other picture shows the same device being handled in a high wind by attendants in preparation for a flight.

This invention is said to be the smallest and lightest flying device with which man ever has ventured into the air. It is a sort of parachute kite, ruggedly but lightly and compactly constructed. It is said to be perfectly safe, even when the wind dies while the aviator is aloft, since its parachute nature permits an easy descent.

Flights of considerable duration are said to have been accomplished by the inventor, in spectacular tests in Germany.



Above, Doctor Seehaase carrying his 10-pound folded parachute kite. Below, attendants about to release the retaining ropes for a flight by the inventor

Is a New Ice Age Coming?

Famous Polar Explorer Taking Radio into the Bleak Arctic

By Captain Donald B. MacMillan

When the following special article was received in the office of this magazine, the explorer already had embarked on his eighth expedition into the Arctic to determine, among other things, whether another Ice Age is beginning.

Captain MacMillan is preëminently fitted to discuss this fascinating question. He has missed only two of the last 15 years in the Arctic. In 1908 he voluntarily relinquished his position as a college professor to sail north with Peary on his memorable dash to the North Pole. His observations concerning the advance of the glaciers in the Far North, and the reasons offered by science, will interest every reader.

IT IS always of interest to me upon my departure for the Arctic regions (this is my eighth) to learn just what particular phase of our projected work appeals most especially to the public. This year it happens to be the possibility and the probability of another glacial period.

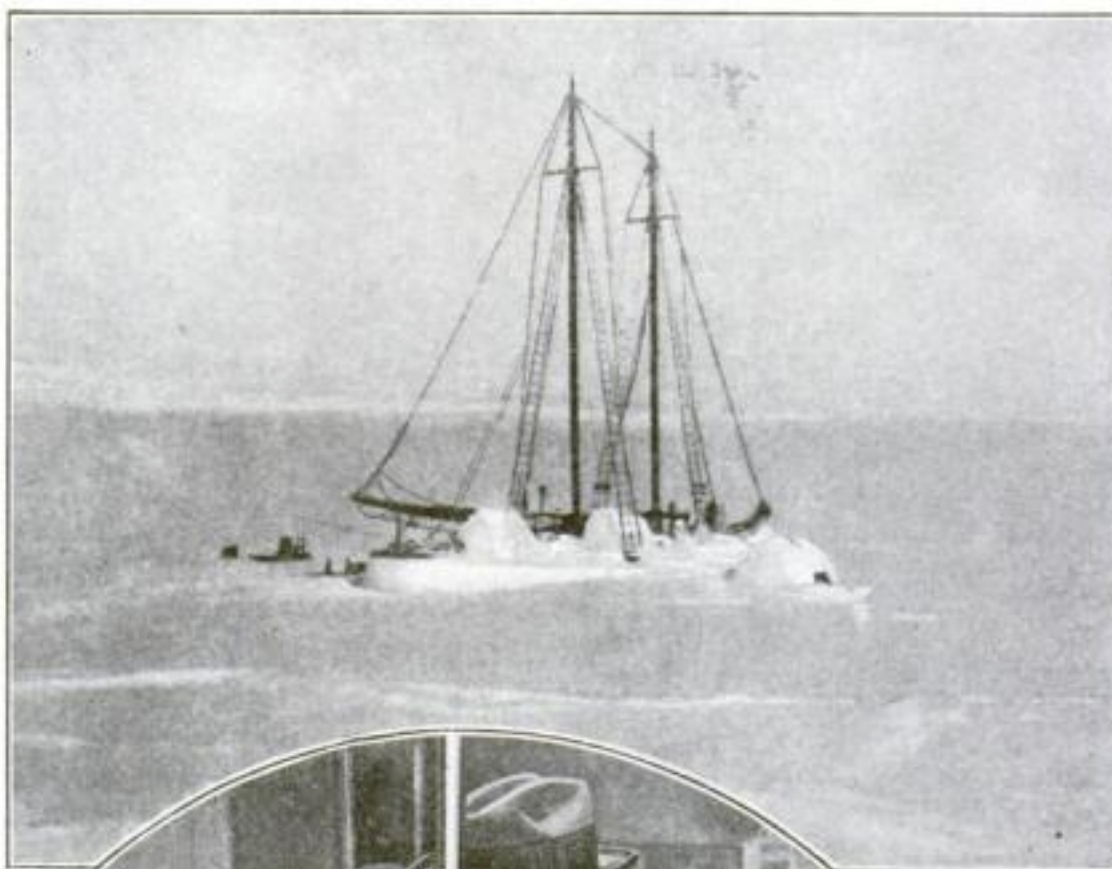
That subject is of great interest, but not more so than the subjects of terrestrial magnetism and atmospheric electricity, in both of which we hope to do good work under the direction of the Carnegie Institution of Washington. The latter is of especial interest just now in view of the tremendous wave of enthusiasm over radio.

We are going far beyond the Northern Lights, planning to winter at Cape Sabine, eleven degrees from the North Pole.

My auxiliary schooner, *Bowdoin*, especially built for arctic work, is equipped with a powerful sending and receiving wireless outfit. In our tests we have heard stations 2500 miles distant, and have communicated with stations in Virginia and the Far West, thus assuring success in this branch of our work if we can penetrate the auroral belt that encircles the globe at about 55 degrees north latitude.

On my last trip, when two degrees beyond the Arctic Circle, every night I heard distinctly the Arlington station at Washington, D. C., and this with a much inferior set than now installed in the *Bowdoin*.

It was the intention of our radio experts to use copper strips on the bottom of the



Capt. Donald B. MacMillan tuning up the engine of the *Bowdoin* for his present trip to the Far North



Captain MacMillan in his radio room on the *Bowdoin*, from which he will send messages from the Far North

Bowdoin as a ground. We decided, however, that the 1700 steel plates on the bow with which we crush and ride over ice will serve the purpose equally as well.

All of our best and ablest geologists declare that we are at the close of a great glacial period when the northern part of North America was covered with 4,000,000 square miles of ice. The first great icefield was developed about 500,000 years ago. Since that time there are very good reasons for believing that we have had three more great glacial stages, each lasting 25,000 years, with interglacial stages averaging 125,000 years. What is the explanation of these climatic changes? Many and sound reasons have been advanced, among which are:

An increased degree of ellipticity (the oval shape) of the orbit of the earth.

A change in the obliquity of the elliptic.

A change in the position of the earth's axis of rotation.

An actual sliding of the external crust or shell around its fluid nucleus.

A continuous change in the distribution of land and sea.

A periodical elevation and subsidence of the surface of the earth.

Why Not another Ice Age?

Since we are absolutely certain that we have had four or more great glacial stages, no good and sufficient reasons can be advanced why we should not have others. The glaciers in the Alps are all retreating, those of the Chamonix Valley from one quarter to one half mile during the last 10 years. The glaciers of Alaska also are lessening in bulk. The Muir Glacier has retreated seven miles in 20 years. Therefore, it comes as a surprise to geologists when I tell them that all glaciers in the Far North are advancing, and have been for at least the last 70 years, as clearly proved by the maps and accounts of our early explorers.

My own observation during the last 15 years confirms this. If they are advancing, why? Is it due to an increase in humidity resulting in an increase in snowfall, or a re-elevation of the northern lands? Mountains are being covered, valleys are being filled, coastlines and islands obliterated. Vegetation is being killed, animal life consequently being destroyed, and the icefields of our North

Atlantic are increasing in area and adding to the dangers of navigation.

Greenland has an area of 600,000 square miles. Today 500,000 are covered with ice. A covering of the remaining 100,000 will influence life considerably, in that millions and millions more tons of ice will drift southward yearly to cool our waters and lower the mean annual temperature.

Ellesmere Land, now slowly being ice capped, will aid in bringing about this result. The result will not be marked until the hundreds of glaciers now filling the valleys reach the sea, when each will send out its fleet of icebergs to add to the already congested northern waters.

How rapidly are these glaciers advancing? This is one of the purposes of my expedition—to mark clearly for future reference the faces of many of our largest glaciers. When other explorers return in future years, they can bring us back something definite. Had Kane, Hayes, Hall, Greeley, and Peary done this, they would have made invaluable contributions to science.

WITH this promise to Science, Captain MacMillan's article concludes. What are the potentialities of the information he submits?

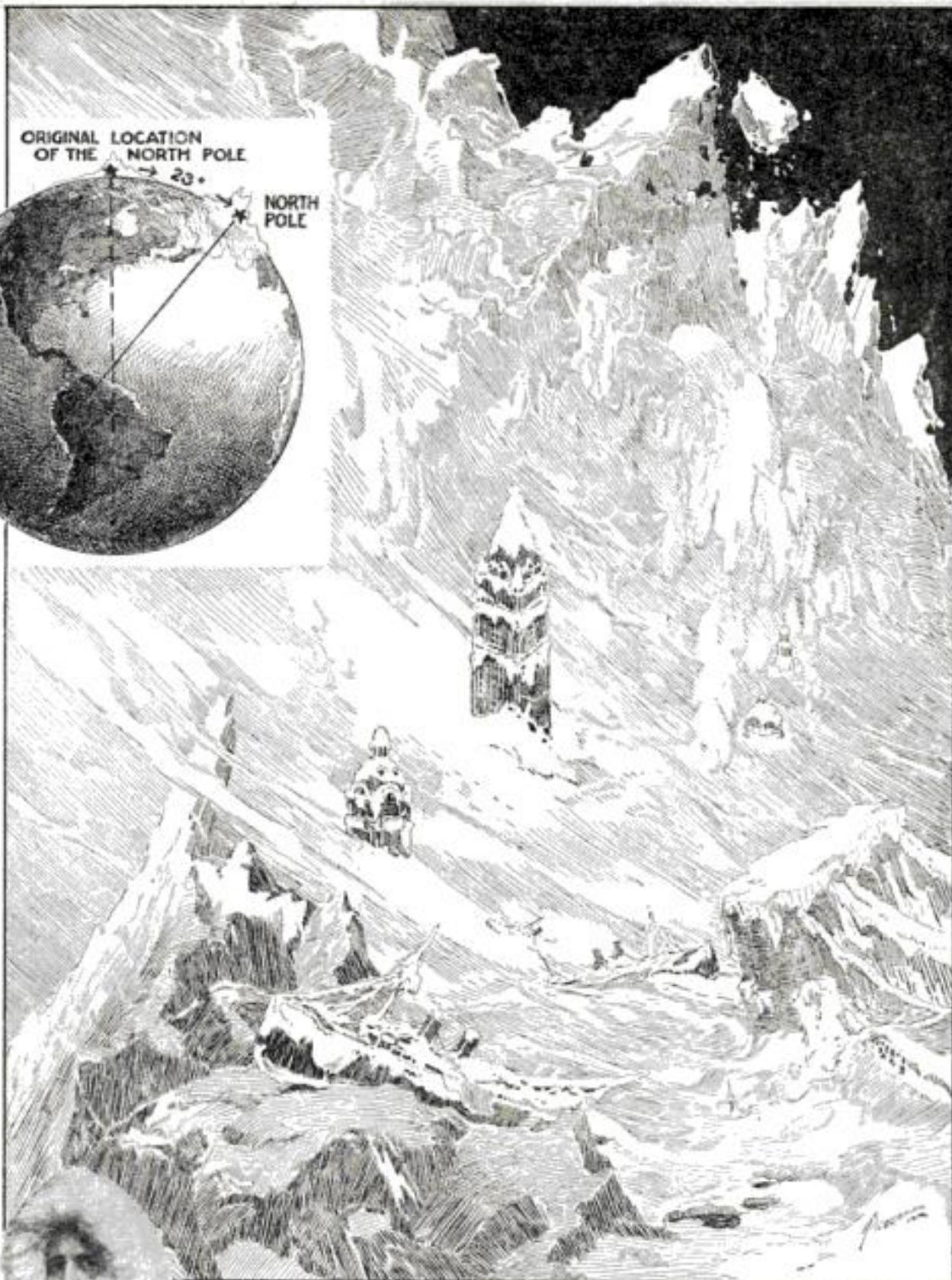
For the first time in the history of polar exploration, as Captain MacMillan modestly states, his expedition will plant landmarks in the vast fields of arctic ice to permit scientists of the future to forecast exactly when the earth will know its next Age of Ice, when a great portion of northern North America may lie buried like the poles beneath huge mountains of solid ice; when vegetation may disappear from the Northern Hemisphere; when man and animals may die and the earth be habitable only near the equator.

Science tells us that today we are at the end of a glacial period of 25,000 years, one of three to five such periods the world has known in a half million years. The interglacial periods—those when the midlands of our globe are as we see them now—last for 125,000 years or more, so immediate fear need not enter into our consideration of the possibility of a return to the Age of Ice.

While science can only theorize as to the cause, it can tell almost with certainty the history and effect of the previous glacial periods. Their stories are written in the face of the earth; in the contours of mountains, the beds of streams, the shore lines of inland waters, the depths of valleys. For when billions of tons of ice move irresistibly over the land, they hew, cut, and carve from their path anything that threatens to halt their progress, smoothing the mountain faces, leveling the hills, gouging out the valleys and altering the cliffs.

The next Age of Ice may obliterate a civilization that it has taken mankind centuries to achieve. Great cities may be swept away before the relentless march of the glaciers. The crumpled stones of their tallest structures may be returned into the earth whence science snatched them or carried on by the flood waters of the melting period into the seas.

Possibly this happened in the last age of ice. Possibly before



How our artist pictures the next great Ice Age. The glaciers, in their relentless advance, sweep away and crumble the tallest skyscrapers of our cities, blotting out the modern civilization built by science. The inset illustrates one of the scientific explanations of glacial periods—the change in the earth's axis of rotation and consequent shifting of the poles



Will our descendants wear clothing like this? Here is Captain MacMillan dressed in a "parka" of arctic furs

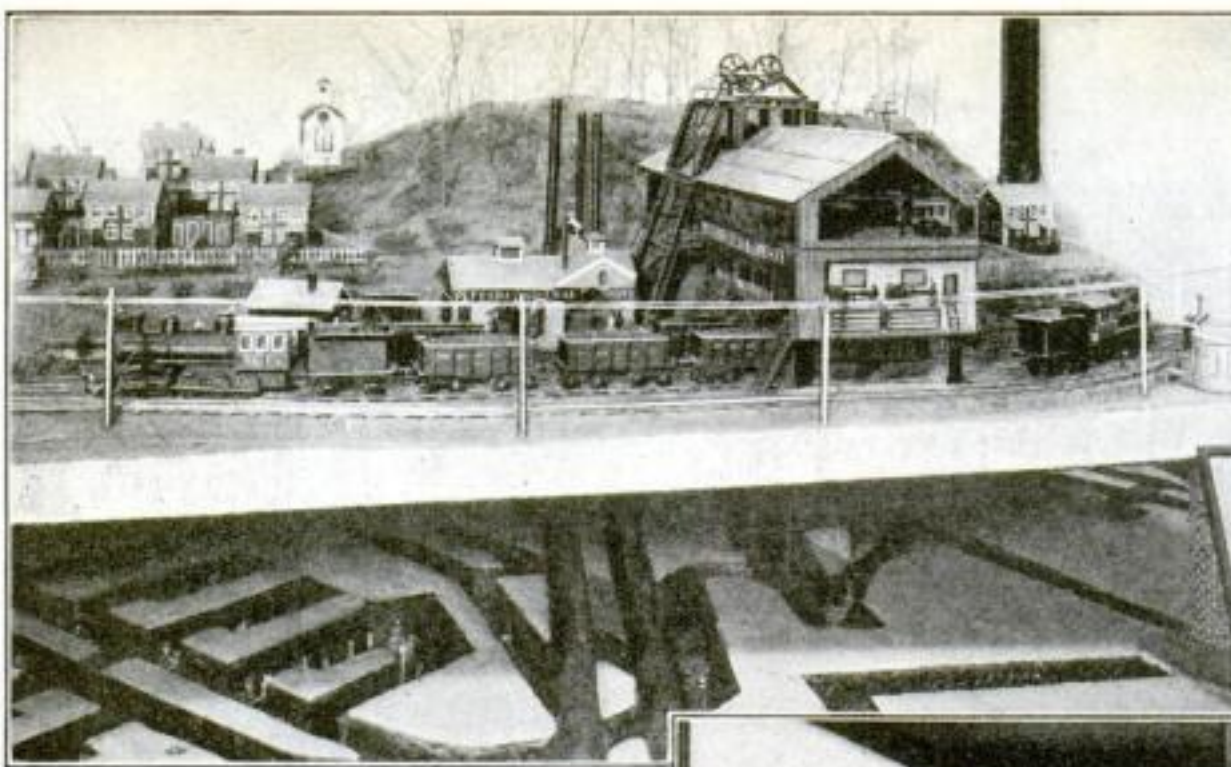
that time America, Europe, and northern Asia knew a civilization beyond that of which we are now so vain! The present sum total of human knowledge may have been surpassed prior to the last advance of the devastating ice. All the scientific discoveries that make our lives pleasant and safe may have been in the hands of the ancients whom the last glacial period removed from the earth.

These fascinating mysteries of

the past and the future lend special interest to Captain MacMillan's expedition—an interest that has been heightened, from the standpoint of the public, by the present widespread use of radio. Radio enthusiasts all over the country are ready to tune in on WNP—"Wireless North Pole"—the call number assigned the *Bowdoin*, which carries the first broadcasting station ever to move over arctic ice.

Radio Expert of the Expedition

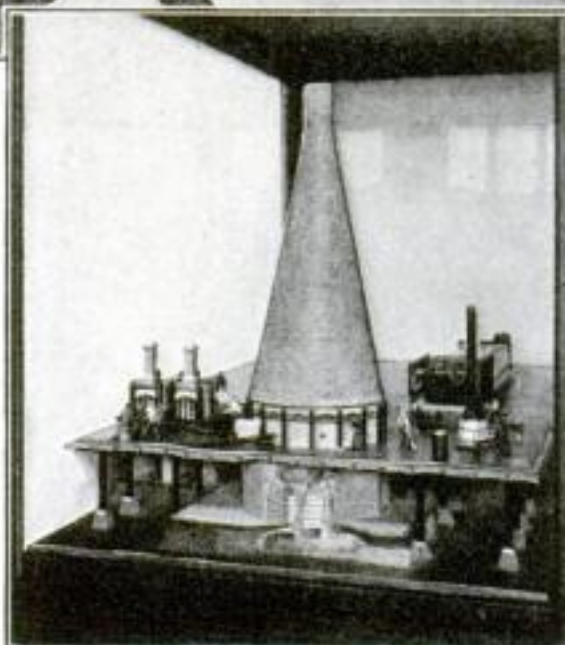
Hiram Maxim, dean of all radio amateurs in America, was responsible for the selection of Donald Mix, of Bristol, Conn., as the radio operator of the expedition. Mix's fellow members of the American Radio Relay League have agreed to do their best to maintain communication with WNP at all times. Messages from the *Bowdoin* will be broadcast by transmission from WJAZ station in Chicago. In addition to keeping the world informed as to the progress of the expedition, the *Bowdoin's* radio equipment will permit the crew to listen in on the popular radio programs, a diversion new to polar expeditions.



Tiny Models Illustrate Industrial Methods

LITTLE models of industrial plants, revealing in easily grasped detail the construction and operation of factories, mines, furnaces, etc., are on exhibition in the Division of Mineral Technology, in the United States National Museum at Washington, D. C. Two of these are illustrated herewith—the shaft coal mine above and the pot glass furnace at the right.

The model above shows the shaft buildings, tipples, miners' houses, and underground workings in which miners are seen cutting coal by machinery, every detail built accurately to scale.



New Railroad Ditcher Is Versatile Machine

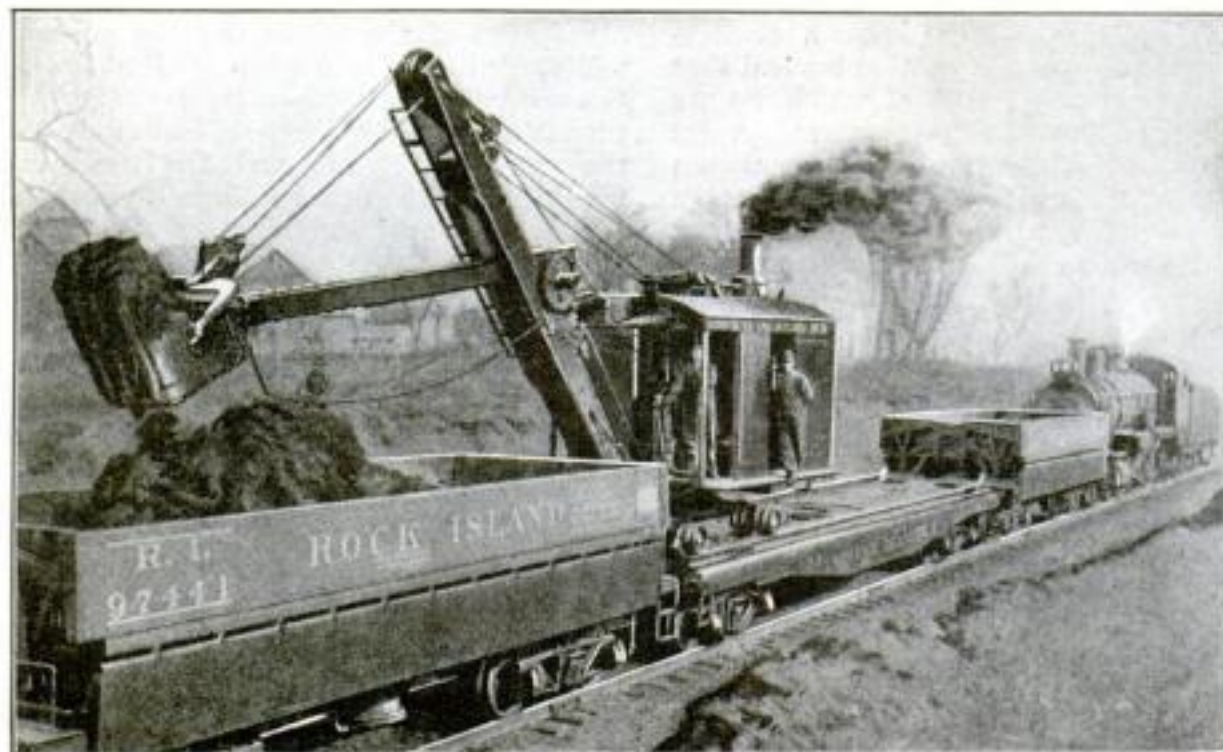
HIGH efficiency, extreme mobility and versatility, and low maintenance cost are said to be features of the improved heavy duty, revolving type railroad ditcher shovel shown below. It is possible to mount this machine on railroad trucks of standard or special gage, traction or continuous tread trucks. This adaptability makes the same machine available for use in cleaning ballast, laying rails, ditching rights of way, loading and unloading, and stocking coal. It may also be used as a locomotive crane and has numerous other utilities.

The machine also is designed for ready

conversion to a steam shovel, crane, single line clamshell, or dragline outfit. All points exposed to intense stress are reinforced.

Relief for the Rheumatic

MORE than 4000 sufferers from rheumatism are said to have enjoyed an 80 per cent amelioration of symptoms under the bacteria injection treatment given 5000 patients during the last four years at the clinic of the New York University Medical College. In several instances the improvement effected is said to have been equal to a cure.



Wide use of this new railroad ditcher, because of its remarkable mobility and versatility will, it is claimed, render unnecessary many machines now in use

Safe Milk-Bottle Carrier for Children

NO LONGER is there any reason why four-year-old Buddy should go forth to the store with a dime, some pennies, and a milk bottle and come back sobbing in a few minutes, penniless and milkless, except for what is splashed on him. Unless he falls down, the bottle carrier here shown will be a safeguard against childish carelessness.

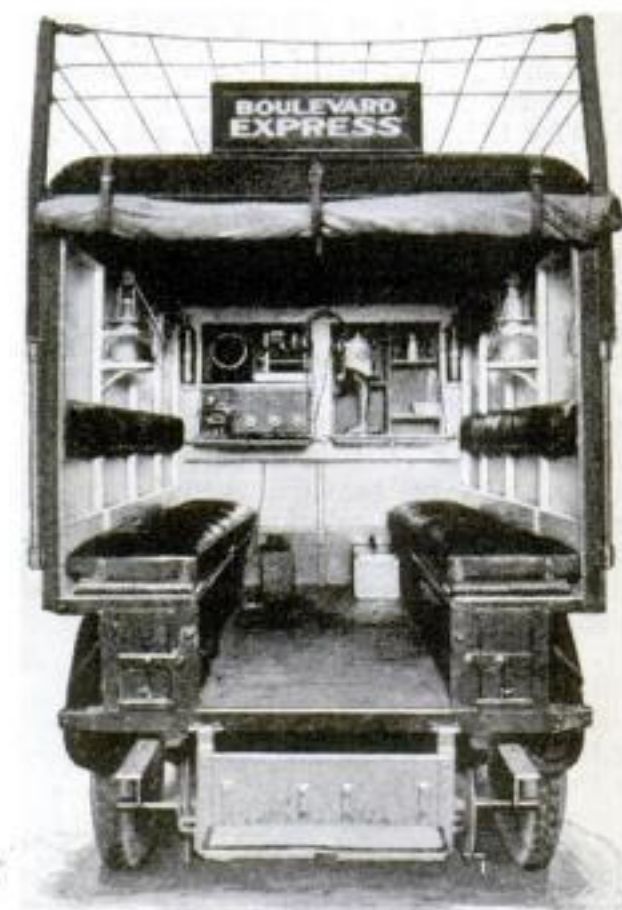
This carrier holds the milk bottle securely once the wire cross piece has been locked in place. The grip may be adjusted to fit a bottle neck of any size, and the wooden handle gives comfort to the one carrying it, without danger of slipping.



The handle in use

A Wireless Service Truck Answers "SOS" Calls

A WIRELESS sending and receiving set has been added to the equipment of the service truck operated by a Los Angeles transportation company. This truck is stationed halfway between Los Angeles and San Diego, Calif., keeping in touch with the home station, so that almost instantly it can be advised of a com-



Note wireless set installed in truck

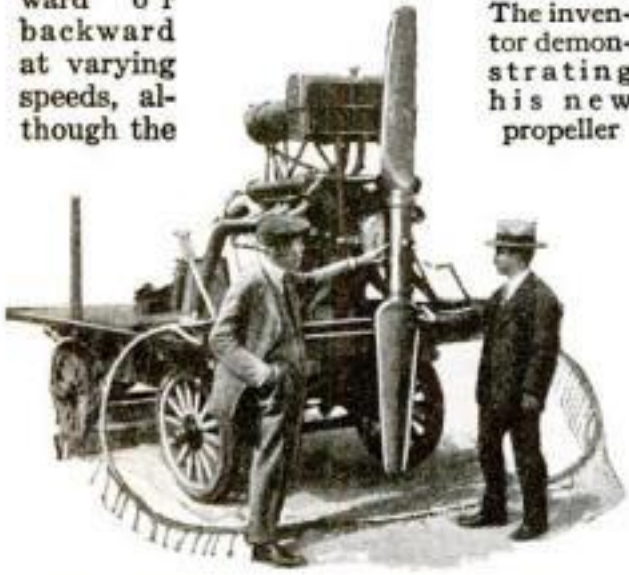
pany truck in need of repairs along the road between the two cities. It also answers distress signals from private cars, the owners, of course, paying the standard rate for whatever help is rendered.

The owners of the service truck believe that before long such wireless equipped repair cars will be maintained on principal highways all over the country.

Airplane Speed Controlled by Adjustable Propeller

SHOWN below is Spencer Heath, of Baltimore, Md., demonstrating to Major-General Haraguchi, of the Japanese army, his recent invention, an airplane propeller with adjustable blades that may be altered in pitch simply by pushing a button. This feature is said to make possible a wide range of speed as well as to provide an effective brake to be used in landing.

Mounted on a trailer truck, the Heath propeller proved capable of driving the truck forward or backward at varying speeds, although the



The inventor demonstrating his new propeller

blades revolved at full speed throughout. One adjustment enabled the truck to remain stationary while the propeller was revolving swiftly.

Among the advantages which the inventor claims for his propeller are these:

It provides aircraft with a variety of speeds, instead of only one speed, as at present. It supplies a brake when revolved in a reverse direction, and in consequence obviates the necessity of a long run in landing. It permits tuning up the engine of an airplane without the necessity of checking the plane; for, when set at neutral, it produces no forward impulse.

Metal Chain Will Prevent Finger Sucking

SMALL children can be cured of the finger-sucking habit if an arrangement of bands and dangling metal links is clamped around the end of the thumb or finger, says the inventor of this device.

When the child attempts to put the finger, with band and chain attached, into its mouth, the metal parts come in contact with the tongue and the roof of the mouth. The result is unpleasant, but not painful.

After experiencing this disagreeable sensation a few times, the child will be cured of the habit, the inventor claims.



Dangling links hung from metal bands discourage thumb sucking by infants



New Parlor Golf Game Played with Manikins

MANIKINS that play real golf on the parlor floor, under the control and direction of players, feature a new indoor golf game that includes tees, greens, bunkers, and even the water hazards of the outdoor game.

The game is played with a club resembling a driver, which has the figure of a miniature golfer in place of the usual

wooden head. The arms of the manikin are pivoted, so that when the player pulls back a lever in the club handle, the doll swings a tiny golf stick and strikes a small celluloid ball.

Considerable skill is required. If the little player is not directed properly, he will fizzle completely. Length and direction of the strike both are in the player's control.

Convenient Bridge-Score Pad Clamps to Table

How pad is attached



EVERY one who plays bridge knows what an annoying article the score pad is. Sometimes you can't find it when you're ready to play. When you have found it and have started the game, the pad is likely to evidence an exasperating habit of traveling around the table, getting mixed up with the cards, or falling to the floor. Or the pencil may be lost.

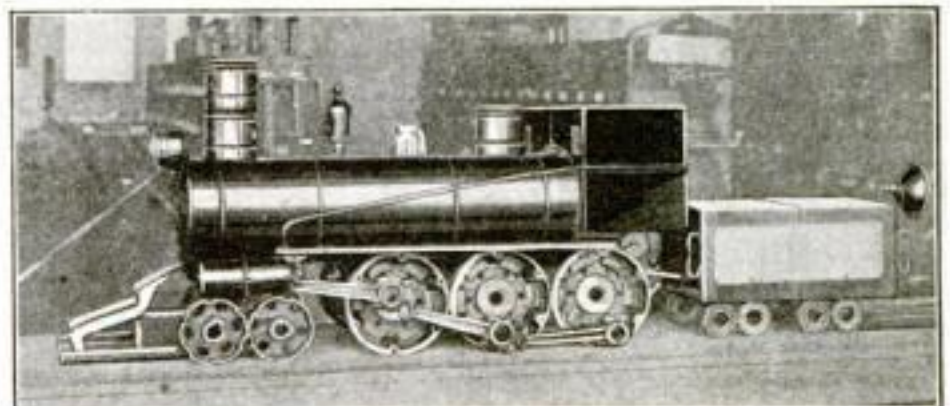
These annoyances are eliminated by a bridge-pad holder that recently has been put on the market by a Connecticut manufacturer. A spring clamp holds the pad securely to the table, so that it is always ready for use at the score-keeper's side and can be written on without being held in place by the hand. The outfit includes a refillable pencil and a socket for the pencil that prevents it from being mislaid.

THE number of living organisms in one single gram of soil, no more than a teaspoonful, exceeds 40,000,000, according to a census taken at a British government experiment station.

Midget Locomotive Made of Old Ford Parts

A MINIATURE locomotive constructed of Ford parts is attracting attention at Culver City, Calif., where it is being displayed by De Witt Brady.

The connecting rods are the only parts used in the motor car that serve the same purpose in the locomotive.



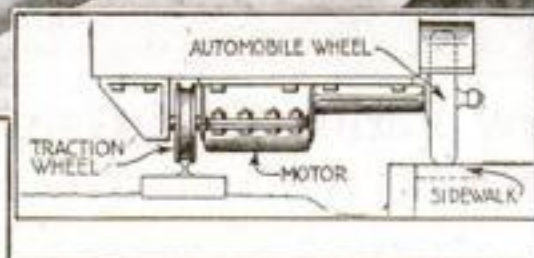
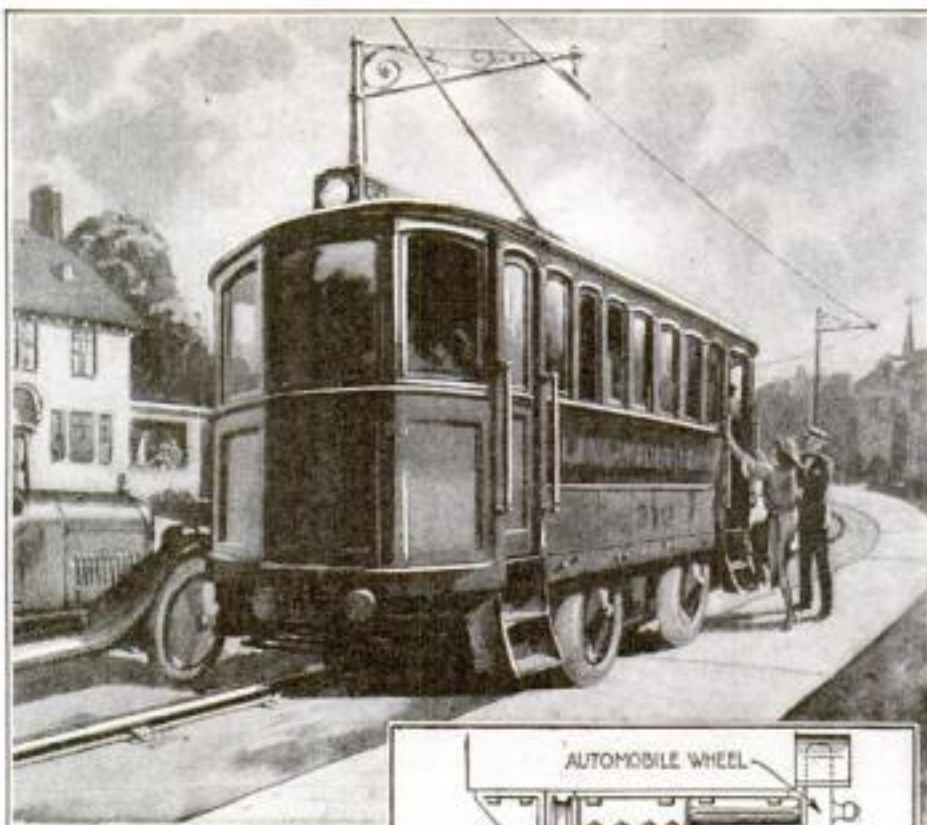
Ford parts were used throughout in building this locomotive

Monobus May Bring Cheaper Rides

THE monobus, a hybrid of trolley car and autobus, has been suggested as the possible solution of transportation problems in suburban districts. By its use the cost of installation and expense of maintenance could be reduced, it is claimed, to the limits demanded by infrequent trolley service in thinly settled communities.

The monobus would be supported by two trolley-car wheels and two bus wheels. The trolley-car wheels would be located nearer the center of the bus than the truck wheels, and would run on a monorail laid on the edge of the highway. The auto wheels would make use of the paved or dirt areas. Rapid transportation would thus be confined to one side of the road. Very little pavement, if any, would need to be broken to prepare the railbed. Either an overhead trolley driving electric motors, or gas engines, could be used for motive power.

The main advantages claimed over an



Our artist's conception of the proposed monobus. The diagram illustrates how one rail and a sidewalk would provide traction

automobile bus are a diminished wear on roads, and reduction in tire cost, since there would be but two tired wheels, on which only 40 per cent of the load would fall.

Remarkable Sun-Dial as Accurate as a Watch



ONE of the most unusual sun-dials in existence is that at Columbia University, New York City, presented recently

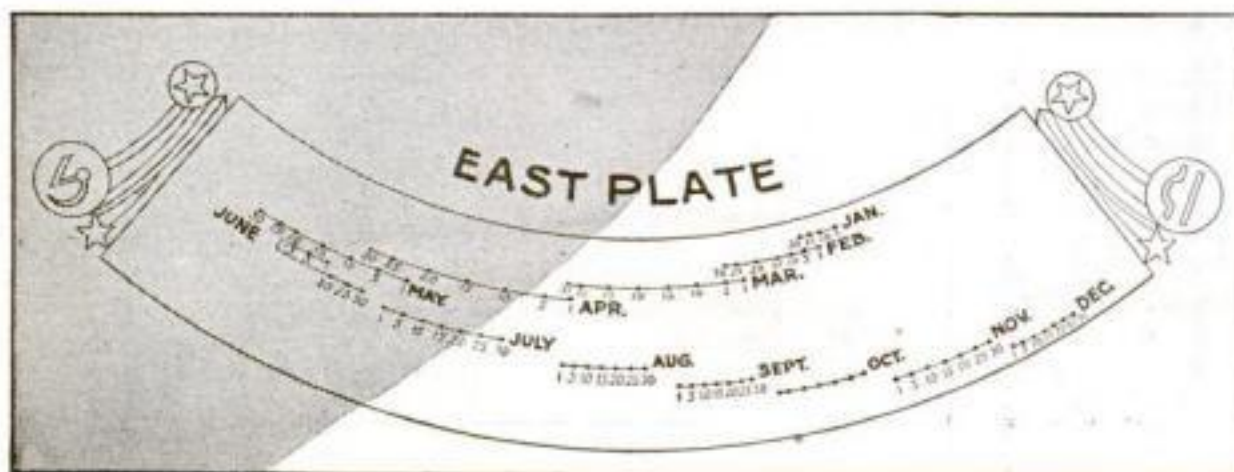
by the class of 1885. A 15-ton granite sphere casts a shadow upon the base so that the east and west edges of the shadow exactly pass through two marked points at high noon on any day of the year.

Two bronze plates east and west of the great ball are marked with a series of lines and points. Thus, for the tenth of April, at noon, standard time, the shadow crosses the April lines on the two plates at points marked 10.

If the shadows are observed simultaneously, the moment the shadow lies as above stated is high noon.

At least two months will be indicated by the shadow on each plate, but only one month by both.

The calculation of these dial plates required months of work, first, because standard time was not the same as astronomical time, as determined when the sun reaches the zenith; secondly, because the base was a cone and the shadow a cylinder, making it necessary to compute the shadow line on the conical base.



Indicating noon, April 8 or July 22, determined by the shadow on the west plate



Tiny 18th Century Watches Rival Modern Handiwork

MODERN jewelers who have produced a "dime size" watch movement, small enough to be mounted on a finger-ring, point to the achievement as an example of the progress made in the watchmaker's art, but our illustration shows that small movements are nothing new.

The little timepieces in the handles of these jeweled knives were made in the eighteenth century, almost two hundred years ago. The production of such a small movement entirely by hand tools affords as fine an example of watchmaking as anything the present-day jeweler can offer.



Dr. W. D. Bates and his lie detector

Lies Read in the Eyes by Novel Detector

LIES, even those harmless lies that lubricate so many of Life's situations, promise to become hazardous luxuries if the "retinoscope," a lie-trap devised by Dr. W. D. Bates, noted New York City ophthalmologist, is vindicated by experience and comes into wider use.

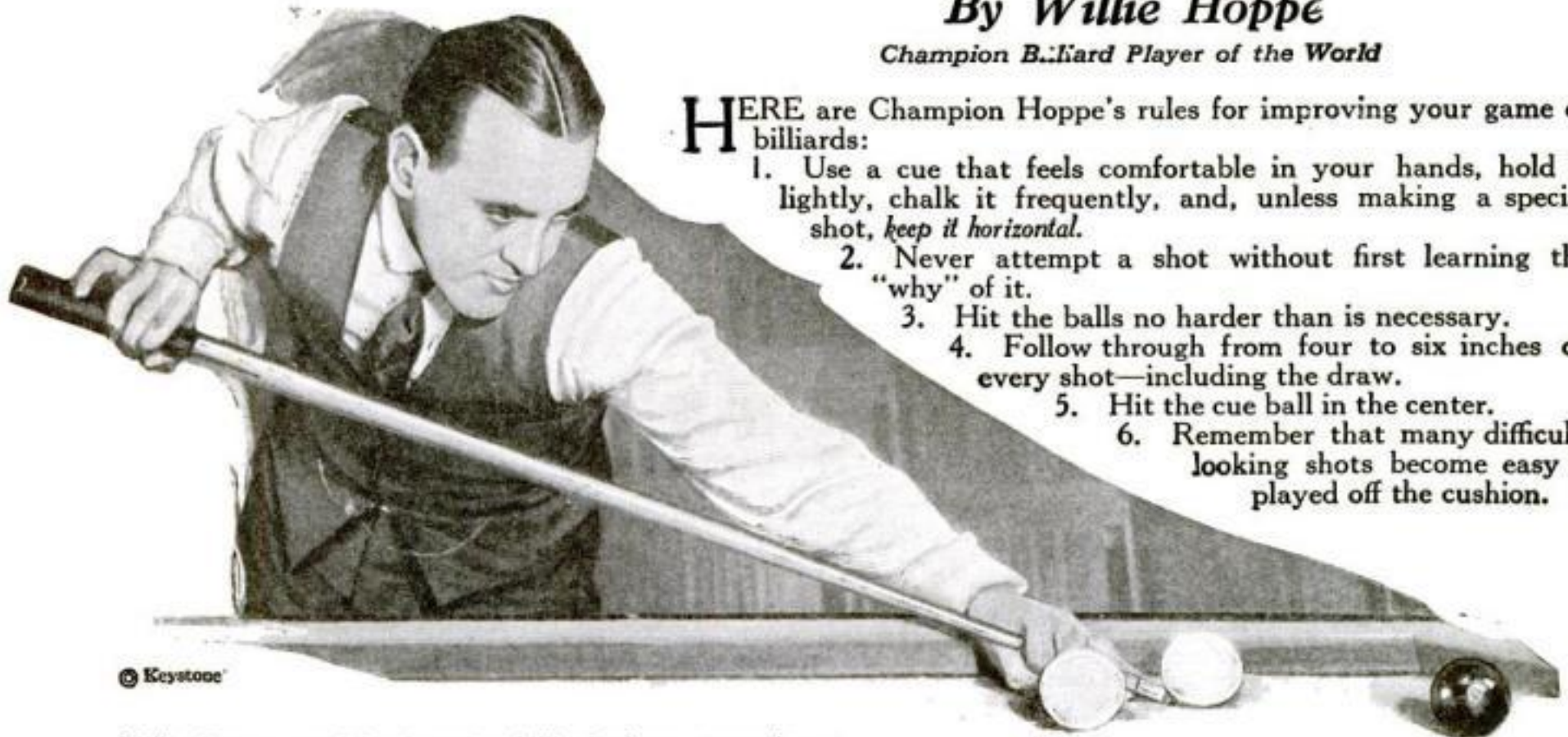
According to the inventor, prevarication produces a mental strain, a generally conceded contention. This, he says, results in a temporary nearsightedness. It is this effect which is detected with disconcerting accuracy, it is said, by the retinoscope.

The instrument reflects a bright light into a mirror. The suspect's eye is studied through it while he reiterates the doubted statement. If he is drawing upon imagination rather than memory, the shadow of the retina, according to Doctor Bates, moves in a direction opposite from that of the shifting mirror.

Mastering the Science of Billiards

By Willie Hoppe

Champion Billiard Player of the World



© Keystone

Willie Hoppe, world's champion billiard player, executing a typical draw shot. Notice how he holds his cue loosely between thumb and forefinger, using the remaining fingers as a guide

HERE are Champion Hoppe's rules for improving your game of billiards:

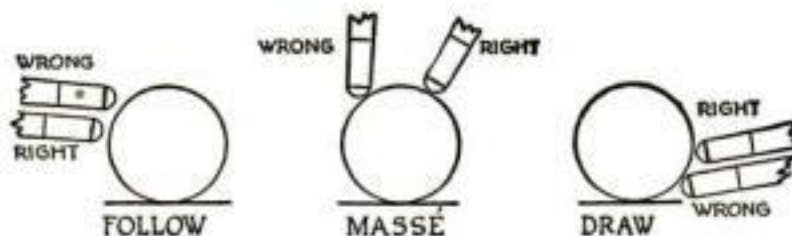
1. Use a cue that feels comfortable in your hands, hold it lightly, chalk it frequently, and, unless making a special shot, keep it horizontal.
2. Never attempt a shot without first learning the "why" of it.
3. Hit the balls no harder than is necessary.
4. Follow through from four to six inches on every shot—including the draw.
5. Hit the cue ball in the center.
6. Remember that many difficult-looking shots become easy if played off the cushion.

NO ONE would dream of plunging into deep water without first learning how to swim. Yet almost every day I see men attempting to play billiards—one of the most complicated and scientific games ever devised—with no knowledge of its fundamental principles beyond the fact that it consists of knocking three ivory balls around a felt-covered rectangular table with a tapering stick called a cue.

That may seem like an exaggeration, but I assure you it is not. Possibly 90 per cent of those who will tell you they "play billiards" have not the remotest conception of the definite scientific principles upon which the game is founded. Every billiard shot is a scientific problem, the solution of which requires practical knowledge of mathematical and mechanical truths and a fine adjustment of the player's mental and physical being. Although there are thousands who play at billiards all over the world every day, there are less than 10 who may be called first class players and certainly less than 100 who play the game well enough to turn in creditable scores day in and day out.

Of this little handful of expert players some of them, I feel sure, possess no better physical equipment for the game than those who must be classed as "dubs," but they have succeeded because they have learned to play the game with their brains—that is, scientifically. The average man who has enough interest in billiards to attempt to play the game occasionally, with a little thought and a little intelligent practice can bring about an almost magic improvement in the quality of his play.

The first and most important step to be taken in improving one's billiard game is a proper adjustment of the mental attitude—the psychology. Take the game seriously, and develop confidence in your ability to play it. The value of self confidence was brought home vividly to me early in my career as a professional player. On January 15, 1906, when I was 18 years old, I was

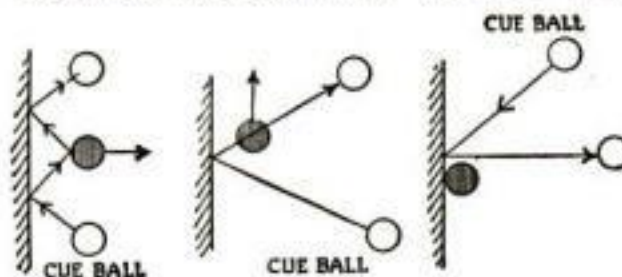


Right and wrong positions of cue in striking the ball for three of the most important and useful billiard shots

playing Maurice Vignaux in Paris for the professional championship of the world. Although I had been playing in public for 11 or 12 years, I was nervous. It was my first championship match. Vignaux was a four to one favorite. When we began to play, however, my nervousness left me, for I concentrated on the game and tried to imagine I was merely practising on my own table at home. In France they divide a match into two periods. At the beginning of the second half it was anybody's game. In my first inning I found myself confronted by a ticklish shot. All the effect of the "self-kidding" I had been doing left me. Frankly, I was scared. If I should miss the shot, Vignaux would be left in excellent position to start a long run and win the match.

Should I try to make the shot, or should I miss purposely with the idea of leaving the French master out of position?

I hesitated before answering. Then I said to myself, "Willie, you're not going to get very far if you're going to be afraid to take chances. You've made harder shots than that a hundred times. Go to it!" So I chalked my cue, made the shot—and



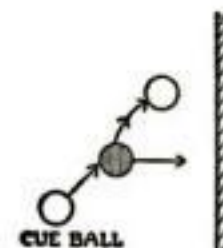
Three ways in which apparently difficult shots can be executed easily by hitting the cushion before striking either object ball

then ran 93, the longest run of the match.

That shot was the most important of my life—not because it virtually won the match and my first world's championship, but because it taught me something that every billiard player should know—never to attempt a shot unless you intend to make it count. Since that time I've been tempted

to play safe many times, but I've never done it.

That, then, is the psychology of billiards. Now for the mathematics and mechanics.



This follow shot Hoppe calls "my most important." By making it successfully, he won his first world's championship match

A correct cue is a most important element in developing mechanical efficiency in billiards. First of all, your cue should "fit" you. If it feels comfortable in your hands, it is the right one; if it does not, it is wrong. I use a cue weighing 19 ounces, but that is only because I have found that a 19-ounce cue is the proper one for me. Also, like most professionals, I use a cue with a comparatively hard tip. Although a hard tip gives less hold on the ball, it furnishes better "touch" and higher speed.

Most amateur players, I believe, would do better to use a soft tip in order to avoid miscues. A miscue in the last block of my match with "Young Jake" Schaefer in Chicago on March 29, 1922, probably prevented me from regaining from him the billiard championship of the world at that time. I was in excellent position with only 32 points to go when the miscue occurred. "Jake" immediately ran out the 10 points he needed and won the match.

Having found the cue that fits you, the

next thing is to learn to hold it properly. Don't grasp the butt with all your fingers as though it were an ax. This is a mistake made by most amateurs. The cue should be held lightly, almost loosely, between the thumb and forefinger, the remaining fingers serving only as a guide. No matter what sort of shot you are attempting, make your stroke smooth and steady—never jerky—and, unless you are trying to produce some special effect, keep the cue horizontal. Do not raise the butt! This causes the ball to spin and impairs accuracy. It is probably the cardinal sin of most unskilled players and one of the principal reasons why they remain unskilled.

Another important point — unless making a massé, or some other shot that does not permit it, always follow through from four to six inches after hitting the cue ball. Follow through even when making a draw shot. The

"draw"—the backward motion that the cue ball takes after striking the object ball—is not produced, as many seem to think, by a quick, jerky, upward movement of the tip of the cue, but by the backward rotation which is given to the ball by striking it below its center. The steadier the stroke and the longer the follow through, the greater will be this rotation. Many players fail in attempting draw shots because they flinch, apparently fearing to give the ball a full forward stroke because they know they are trying to produce a backward motion.

Unless you have some good reason for doing otherwise, always strike the cue ball in the exact center, or just above it. This causes it to travel forward in a straight line and gradually to acquire rotation about a horizontal axis from the friction of the cloth. Stroking the ball that way causes it to go exactly where you want it, and in a straight line.

Don't Hit Too Hard

Another warning—if you hit the cue ball harder than necessary, the result will be almost invariably a "bad leave," that is, the balls will be driven so far apart that your next shot will be a difficult one.

Don't be afraid to chalk your cue, and always chalk it when attempting a draw, follow, English or massé.

For practice in stroking I know of nothing better than driving a ball from one end of the table against the opposite cushion and holding the cue after the follow through to permit the ball to rebound against it. This, unless you are a player of some skill, you will find more difficult than it sounds, for, unless the ball is struck in the center, or exactly above it, a greater or less amount of English will be imparted and it will fail to return to the place from which stroked.

There are, of course, an infinite number of shots possible on a billiard table. To attempt to describe specific shots would be futile, but there are general principles involved in all shots which I shall try to describe briefly.

All billiard shots may be considered as belonging to the following classes or to a combination of them—the carom, the draw,

the follow, the bank, and the massé. Carom is the word used to describe the rebounding of the cue ball from the object ball after striking it. It is probably the shot most frequently used by the inexperienced player. The draw I have already mentioned. The follow shot is quite well described by its name. It is made by striking the cue ball above center, thereby giving it a great amount of



"Young Jake" Schaefer, ex-champion, from whom Willie Hoppe recently regained the world title. Notice the nearly horizontal position in which he holds his cue. Raising the butt of the cue impairs accuracy, Hoppe declares

forward rotation, which causes it to continue on its path after striking an object ball.

Bank, or cushion shots, are probably self explanatory and we shall make no distinction here between those in which the cue ball strikes a cushion before striking



© Keystone
Roger Conti, one of the world's leading billiard experts, demonstrating the massé shot. Note how near the center his cue, held vertically, hits the ball

either object ball and those in which the cue ball strikes one object ball first, then the cushion, and then the second ball. The massé may be called exaggerated English. It is made with a nearly vertical cue against one side of the ball with aim taken almost through the center of the ball. In making it, the left hand may be held upright with the tips resting on the table, or the left forearm may be held rigid against the body and the cue directed against the ball through a loop-finger bridge.

In a massé, the cue ball describes a curved path, permitting the execution of direct caroms that otherwise would be impossible — when the three balls are in line, for example. In a short massé, little force is necessary, although the tip of the cue must "catch" the surface of the ball to give it the rotary motion that makes it curve.

Since the opportunity to score points by direct caroms is distinctly limited in a billiard game, the cushions must be used constantly to cause the cue ball to reach its objective. The angles at which the balls rebound from the cushions furnish the geometry of the game. In this connection, the first thing to be remembered is that when a ball is driven against a cushion without English, the angle of rebound is always equal to the angle of impact.

When it is necessary for the player to cause the cue ball to rebound from the cushion at a greater or less angle than that at which it is directed against it, he employs English. If the English is put on the side at which the ball would naturally rebound if it were not used, the angle of rebound will be lessened; that is, the ball will rebound more nearly parallel with the cushion. If the English is put on the other side, the angle of rebound will be larger; that is, the ball will rebound more nearly perpendicular to the cushion. When using English—unless attempting some other effect as well—hit the cue ball at half its height.

Practice Is the Best Teacher

I can't give any rules for determining the amount of English to be put on a ball. Nothing but practice will teach you that, and you can obtain the best practice, not by playing matches, but by setting the balls on the table and practising the same shot over and over again until you are able to execute it perfectly.

The average unskilled billiardist makes the game more difficult than it actually is by failing to learn the fundamentals before attempting to play. This means work. I am 35 years old and I have practised billiards not less than an hour a day since I was a boy of six. Also, when preparing for a match, I train—on the roads—almost as severely as a pugilist, for billiards is a trying game and good condition of the body and nerves is essential to success.

I do not expect any one who plays for amusement to tie himself down to any such rigid routine as mine, but I would advise him to take as much care with each shot as though a world's championship depended on it.

Armored Monster Once Roamed Texas

24/81



Smallest Full-Grown Horse in the World

THIS is Tiny Mite, the smallest full-grown horse in the world, 26 inches tall and weighing 51 pounds. His diminutive proportions are the more remarkable because he does not come of any diminutive breed of equines. He has as his sire and dam respectively, Baron B. and Lady Raffles, full-sized thoroughbreds and former race horses. Tiny's home is at Revere Beach, Mass., where his owner has erected a special miniature barn for him.

Solid or Pneumatic Tires Worn by New Wheel



A NEW wheel design for motor trucks permits the use of solid or pneumatic tires without changing the wheel. On the wheel in the center may be placed either the solid tire and wide rim shown at the left or the pneumatic tire and rim shown at the right.

Tennis Balls Are Cleaned by Brushing Machine

DIRTY tennis balls, which grime the hands and white sport clothes, now can be banished inexpensively, it is claimed.

But it is the condition and not the ball that really is banished.

Stains of grass or clay are said to be effectually removed by the recently patented brushing machine here shown. This device is screwed to the wall, or to some solid object convenient to the tennis court. The dirty



balls are placed between the brushes through the swinging gate, which is shown open in the illustration.

Two balls can be cleaned at once, their separation being accomplished by a curved arm. When the handle is turned, the brushes revolve, reaching every portion of the balls' surfaces and causing them to leave the machine looking very much like new.

Palaescincus, or "armored dinosaur," as it probably appeared when it roamed the Texas plains ages ago: a restoration from fossilized skeleton (below) found in Texas



MANY thousand years ago this formidable looking creature roamed the plains of Texas. Perhaps it was the original Texas steer. This striking animal is Palaescincus, the "armored dinosaur," a restoration of whose skeleton has just been placed

in the American Museum of Natural History, New York City.

The scientists who exhumed the fossilized remains and made the restoration, say that, despite its forbidding appearance, the beast was really a gentle and peaceful creature that lived on grass. Its spiny armor, it seems, was utilized only as protection.

The creature stood about five feet tall, measured approximately 20 feet from nose to tail, and was about as easy to damage as an armored tank.



World's Champion Hen Has Laid 1300 Eggs

ABOVE is Mrs. Lyle Funk, of Shirley, Ill., holding her prize white Leghorn hen, Lady Anne, said to be the champion egg producer of the world. Lady Anne is 10 years old, and in the nine years that elapsed since she learned to lay has produced more than 1300 eggs, with a total weight of about 175 pounds.

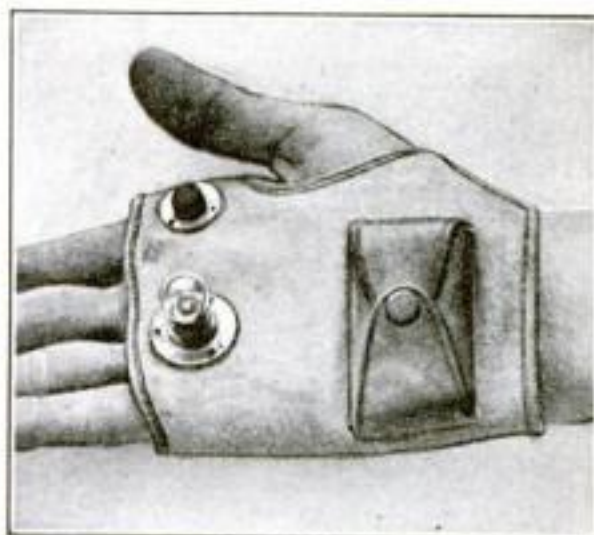
The poultry books say that the world's record for egg production is 1355, held by a hen which has long since passed on. Lady Anne's owner expects her to exceed this record by a wide margin, since she is still a steady producer, and so healthy that any actuary would give her several more years to live.

Burglar Carries Lamp in Palm of His Glove

A SAFE-CRACKER'S ingenious lamp attached to the palm of a glove recently was seized by Detective Captain Sam Street, of San Antonio, Tex.

In the palm of the glove is a pocket, in which is placed a small electric battery. Flat wires lead the current through the switch at the base of the index finger to a bulb at the base of the third finger.

This arrangement enables the burglar to press the switch button with his index finger while shielding the light so that it will not be visible from behind. A sufficient amount of light is projected forward to enable him to read the combination on the safe he is about to rob.

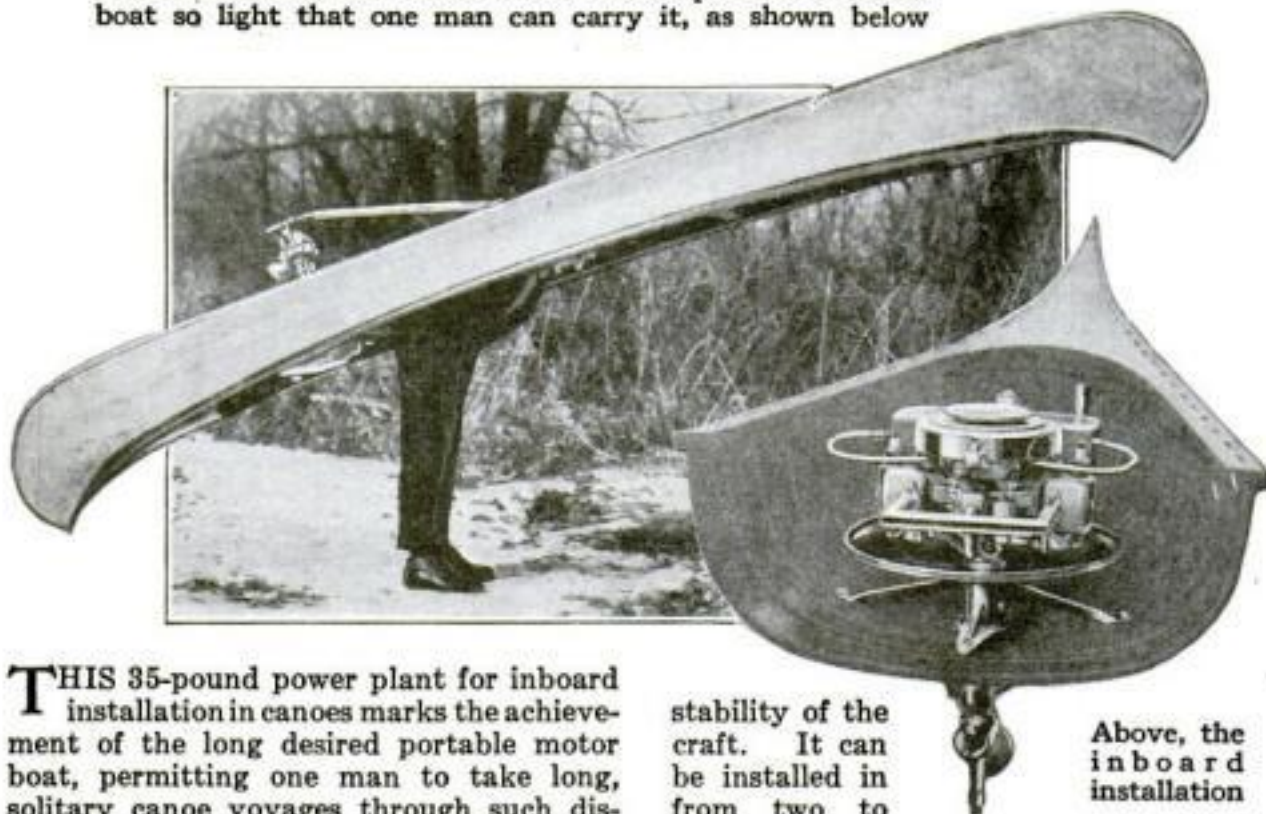


Lamp and switch button in glove

WITH British and French engineers completing plans for a 31-mile traffic tube under the English Channel, a transportation dream 120 years old now seems likely to be fulfilled. This gigantic project to connect Dover and Calais by the world's greatest tunnel will be described with fascinating and authoritative illustrations in an early issue of Popular Science Monthly.

Midget Inboard Motor for Canoes

The diminutive new canoe motor makes possible a motor boat so light that one man can carry it, as shown below



Above, the inboard installation

THIS 35-pound power plant for inboard installation in canoes marks the achievement of the long desired portable motor boat, permitting one man to take long, solitary canoe voyages through such districts as the Canadian lake country, which require frequent portaging.

The motor is constructed so that it lies low in the canoe, thus greatly increasing the

stability of the craft. It can be installed in from two to three hours and removed in 10 minutes. A heavy, diagonal skeg from the tip of the projecting motor parts protects the propeller blades.

A Pocket Check Protector

PERFORATIONS to prevent the altering of checks, long used by business houses, are made available for personal checks by this new, pocket-size perforator.

The perforator is of silver plates, between which the check is placed and



punched. These perforations, opposite printed numerals on the margin of the check, designate the maximum amount.

Crane and Truck Combined in Mobile Lifting Unit

THE mounting of a lifting crane on a storage battery electric truck was accomplished successfully for the first time

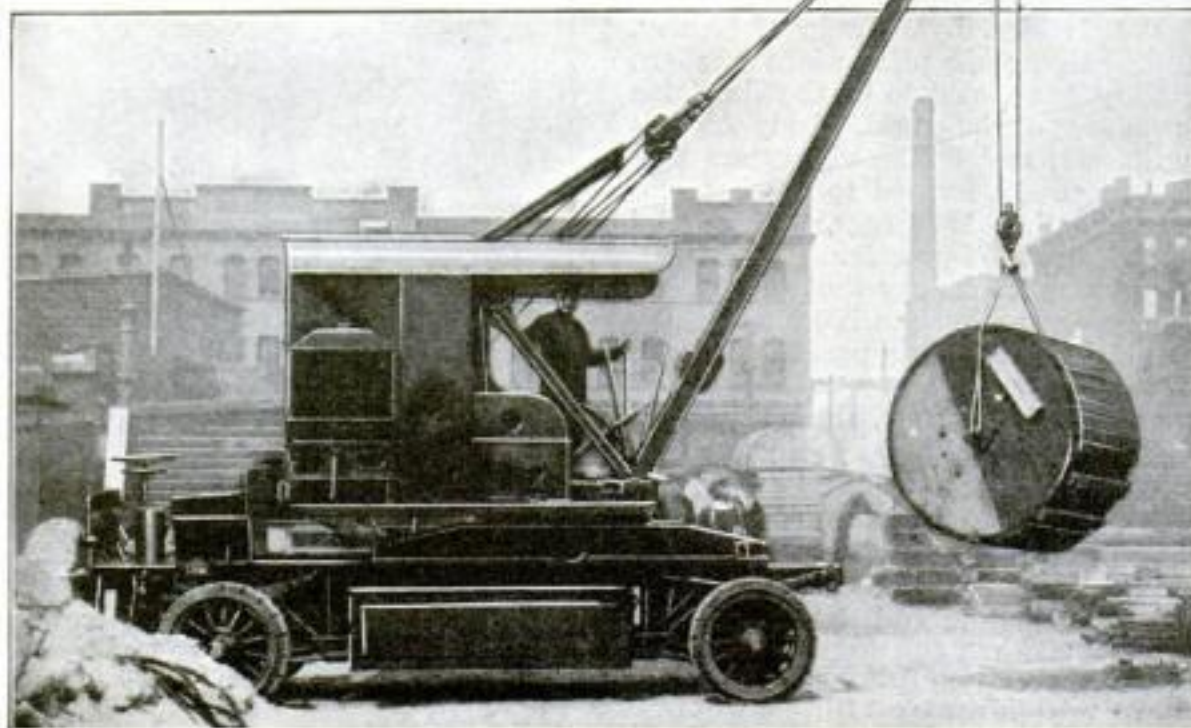
recently by the New York Edison Company.

Since being placed on the truck, one of five tons, the crane has shown a lifting capacity at least 40 per cent greater than that at which it was rated by the manufacturer. This remarkably efficient performance results from the lowering of the crane's center of gravity by the weight of the storage battery.

The crane has been used successfully in such work as handling heavy reels of cable, loading coke and coal and piling manholes and castings. The device can pick up a large reel of cable and place it on a truck in from 30 seconds to 1½ minutes. The only methods practicable before its development required from 10 to 20 minutes for the same work, moving loads in smaller quantities and far more slowly.

The ordinary type of crane cannot be moved from place to place over city streets. The mobility crane makes that possible. Hence it is available for for such usually left

over city of this new easily possible making lifts work as is to riggers.



The powerful electric truck and crane hoisting a large spool of cable



Upright Camp Fire Broiler for Outdoor Cooks

A NOVEL outdoor broiler that stands erect beside the fire has been invented for campers and picnickers. It is supported at the back by a sharp-pointed wire leg that is pushed into the sand or dirt.

The invention really is a wire inclosed in a cooking pan. The flavor of food broiled over a camp fire frequently is spoiled by smoke—a disagreeable feature of camping that is prevented by the new device. Meat can be turned in it without being disturbed, and a fish being grilled will not be broken into unappetizing scraps.

The pan is fitted with a trough at the bottom, in which all juices and grease are caught. This pan also serves to concentrate the heat and keep hot the side already cooked.

A Novel Hacksaw Frame

EVERY mechanic who knows how vital a tool a hacksaw can be will find this recently patented frame interesting.

It is designed to undergo severe usage without springing. In designing the handle,



the inventor remembered the mechanic's comfort and shaped it to his hand. The frame is equipped with devices that allow the blades to be released and tightened quickly, and different sized blades to be adjusted easily. Quick setting of the blades to cut four different ways is also easy.

Filling Station for Pens

FOUNTAIN-PEN filling stations in office buildings, schools, and libraries are interesting possibilities of tomorrow.

The "station" pictured here has been operated successfully for months at the University of Chicago.

A penny dropped in the slot releases enough ink to fill an ordinary fountain pen. You may first drain your pen in the left-hand container and a penwiper may be pulled from the upper "right corner.



He Saved a Million Lives

The Inspiring Story of Pasteur, Great French Conqueror of Disease, Whose Centenary the World Celebrates

By R. E. Martin

THIS year the whole world is celebrating the centenary of Louis Pasteur, the great scientist, who, in point of alleviating suffering, has been called "the supreme benefactor of the human race."

France, the country of his birth, set aside six months in which to honor his memory by a series of fêtes and exhibits, one of which delegates from every country attended. In the United States the centenary is being observed generally by scientific societies and by the scientific departments of colleges and schools.

To the layman the name of Pasteur probably brings to mind only two great scientific achievements—the Pasteur treatment for hydrophobia and the heating process, known as pasteurization, by which milk is made germ-free and suitable for human consumption. These, tremendously important though they are, may be considered as only two incidents or phases of Pasteur's far reaching life work.

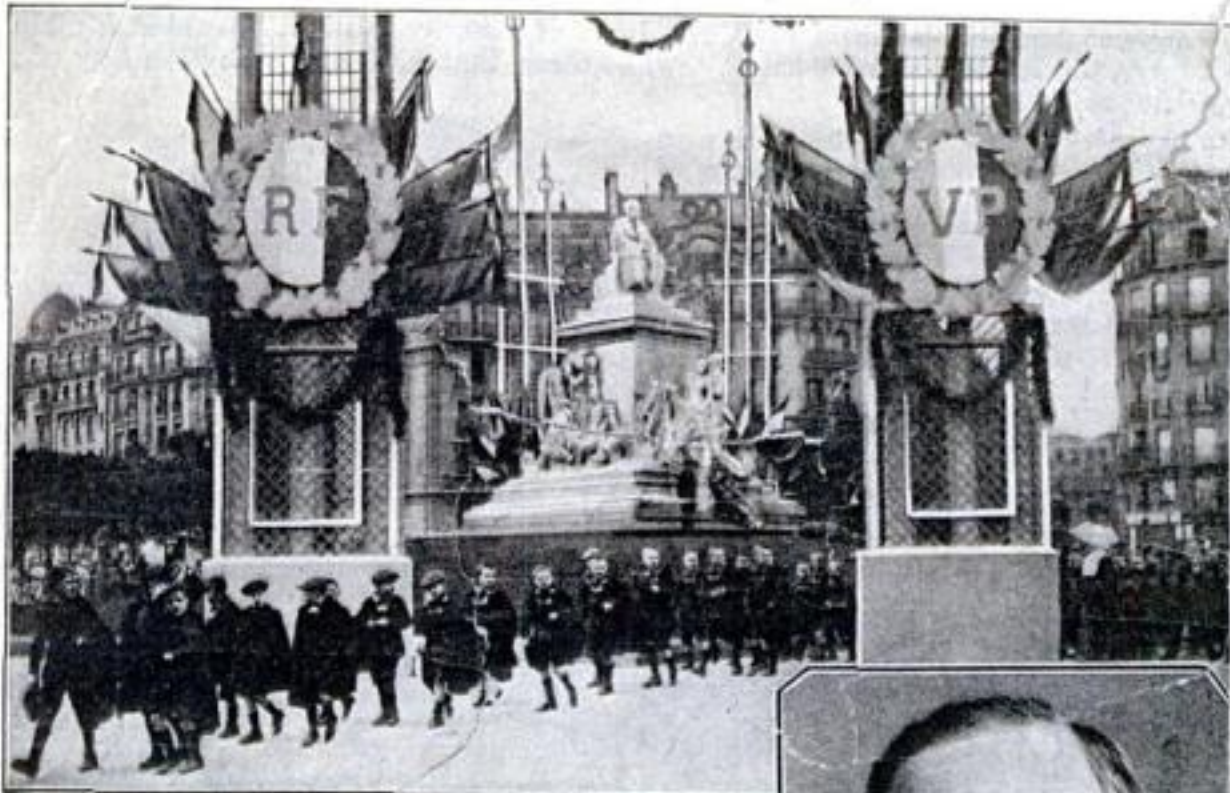
He it was who blazed the trail for modern antiseptic surgery. He it was who first developed the principles by which the medical profession now controls infectious and communicable diseases. By his researches he proved that the virulent plagues from which mankind had suffered for centuries were caused by living microorganisms—germs. And he was the first scientist to learn that these germs could be cultivated by man and injected into the bodies of sufferers to fight the very germs that caused disease.

He pointed the way to the present-day control of such frightful scourges as hydrophobia, tuberculosis, malaria, tetanus, infantile paralysis, leprosy, syphilis, dysentery, diphtheria, smallpox. And thus he saved at least a million lives.

He saved the herds of France from extermination by anthrax, and taught the world his methods so that they might be applied to cattle everywhere.

He saved the silk industry of France by finding the cause and the cure of a disease that was killing the silkworms.

He discovered that living microbes caused the fermentation of wine, beer, milk, and butter, and he taught the wine-makers of France how to grow their grapes so that poisonous fermentations could not develop.



Orphan children marching before the statue of Louis Pasteur in Paris, celebrating the centenary of the great French scientist who has been called "the supreme benefactor of the human race"

Although he was neither physician nor biologist, it is to him that both these sciences owe probably their largest debts.

The amazing feature of Pasteur's life is that his most important work was done after the age of 46, after he had suffered a stroke of paralysis that made him virtually a cripple for the rest of his life.

By training and profession Pasteur was a chemist. He was born at Dôle, the son of a tanner.

As a boy, and even as a college student, this great man showed no extraordinary qualities. In fact, his college diploma



Louis Pasteur

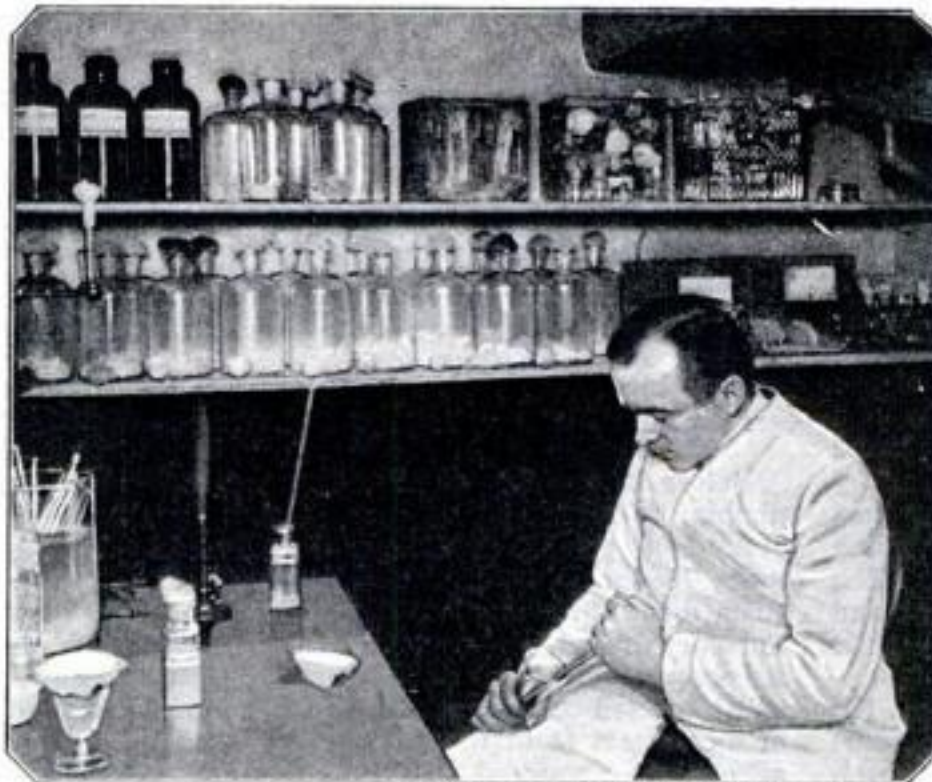
when the air was excluded. He followed up these discoveries by demonstrating in a series of intricate experiments that the germs were not generated spontaneously in the fermenting beverages, but existed in the air.

Not only did his findings teach the vintagers and brewers how to save their products, but when applied to surgery as antiseptic, they have taught the medical profession how to save human life.

Before Pasteur the percentage of deaths from infection after surgical operations had been as high as ninety. Now the most dangerous and complex operations are boldly performed without fear of infection.

It was Pasteur who first taught the doctors to sterilize their instruments by passing them through a living flame. Through his discoveries of the nature and sources of germs was developed the complete sterilization of surgical instruments and dressings as practised in the modern hospital.

In 1865 the French silk industry had reached the verge of ruin through a fatal sickness that had attacked the worms. Up to that time Pasteur never had seen a silkworm, but, at the solicitation of a friend who lived in the south of France, where



Courtesy New York City Health Department

Grinding serum for the Pasteur treatment of hydrophobia, or rabies, in the laboratory of the New York City Health Department. The serum, extracted from the spinal fluid of animals, is converted into liquid form for human injection

the scourge was rampant, he consented to visit the afflicted area and study the disease on the spot. It required six years of patient, discouraging work to trace the mysterious disease to its cause, and to find a cure, but Pasteur at last succeeded, and the silk industry was saved. It was while working on the disease of silkworms that Pasteur suffered the paralysis that left its mark on him through life.

Pasteur's work in every case was done in some field of practical usefulness, to supply some economic or human need; yet Pasteur continuously looked up from this work of the moment into the future. Thus in 1879, long before he had attempted to turn germs of disease into a vaccine which would destroy disease, he wrote:

"Must we not believe that the day will come when preventive measures of easy application will arrest human plagues which at one blow desolate and terrify whole populations, as did yellow fever in its recent invasion of the Senegal and the valley of the Mississippi, or the bubonic plague that has raged on the Volga?"

Saving Cattle

This question he asked in commenting on his work in checking the ravages of anthrax, which two years before had attacked the sheep, cattle, and pigs of France. It was in fighting this plague that Pasteur first was successful in utilizing a germ culture as a vaccine. This achievement science places in the forefront of his discoveries, for the only diseases which today baffle medicine are those of which the germ has not yet been found. Walking one day through a recently harvested field, Pasteur was struck by a peculiar red formation in the soil at certain spots. Investigating, he found that the color was due to cylinders of earth left by worms. Upon making inquiries in the vicinity he learned that the carcasses of animals which had died of anthrax had been buried there.

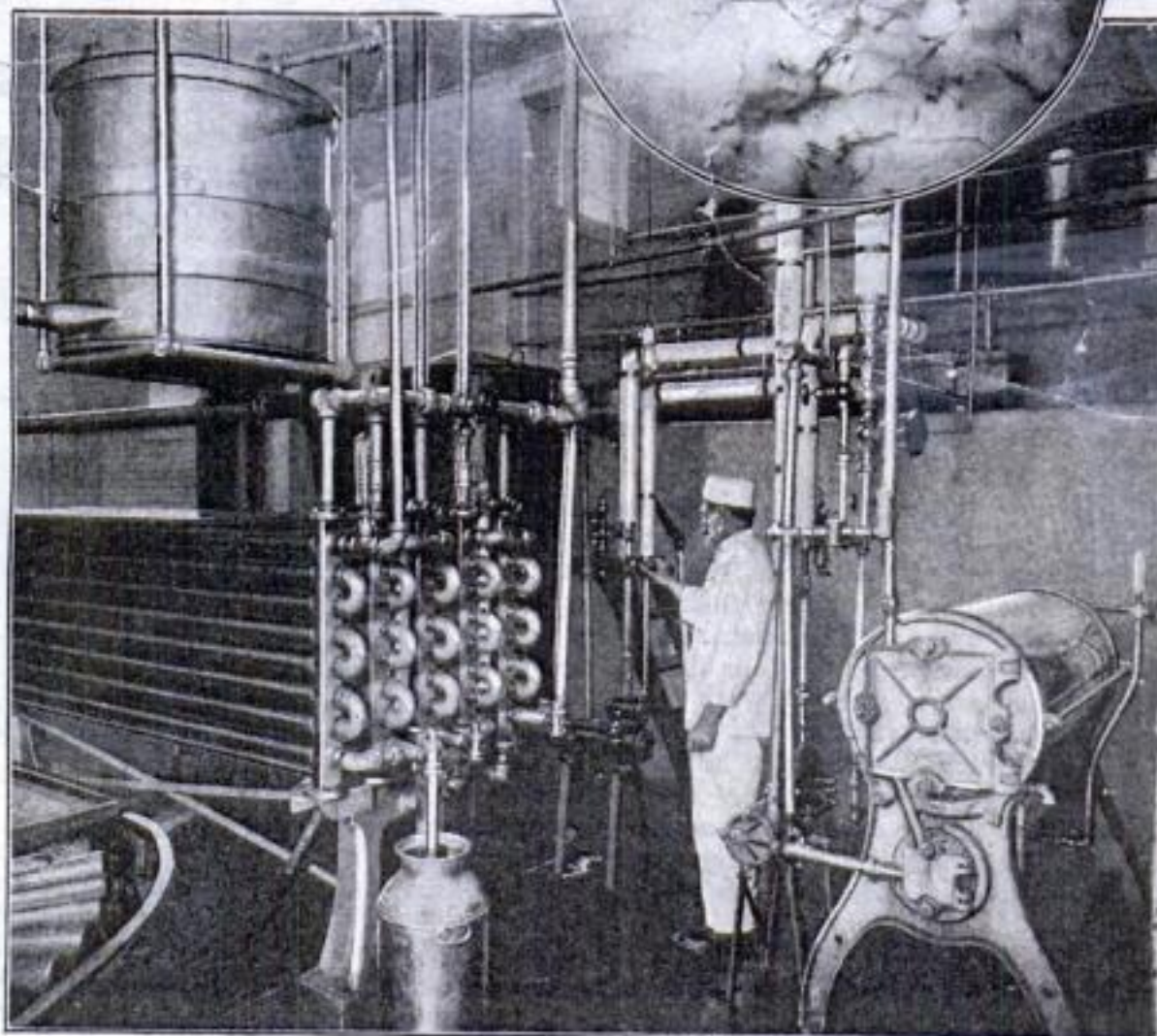
Instantly there occurred to his mind the possibility that the worms were spreading the anthrax plague. Examination of the worms disclosed the presence in them of a germ similar to a germ development found to exist in the blood of animals killed by anthrax. From the blood specimens Pasteur produced germ cultures with which he inoculated healthy animals. The animals so injected developed anthrax and the bacilli of anthrax were found in their blood.

Further experiments disclosed that the germ cultures, if subjected to heat, became weakened in their disease-producing qualities. This fact Pasteur interpreted to mean that in the germs of arrested growth the former virus had become a vaccine. Experiment substantiated his theory, and he announced his discovery, only to be

greeted with derision by scientists, veterinarians, and cattle raisers.

Pasteur, certain of his ground, agreed to subject his theory to a public test, which was arranged at Melun. A herd of 25 healthy sheep was injected with the vaccine. Then these and 25 other sheep which had not been vaccinated were inoculated with anthrax. Pasteur predicted confidently that within five days the animals that had been vaccinated would still be healthy, while those that had not

At the right, a highly magnified view of milk that has been soured by millions of bacteria. In milk held at a temperature of 68° F., bacteria multiply more than 4000 times every 24 hours



Pasteurizing milk in a large dairy plant. Disease bacteria are destroyed by Pasteur's scientific process of heating and cooling the milk. Pasteurizers and

milk holding tanks are shown in the gallery. In the coils at the left the milk is cooled after it is taken from the tanks where the bacteria are destroyed

Courtesy Borden's Farm Products Co., Inc.

received the vaccine would be dead. What he predicted came to pass. Scientists who had scoffed now applauded. Science accepted his discovery. His vaccine was put into use and the herds of France were saved.

Pasteur Develops Rabies Vaccine

Before the days of Pasteur, hydrophobia, or rabies, always was fatal. Of every 100 persons bitten by rabid animals, 16 developed the disease and all of them died. Studying the disease in dogs, Pasteur reached the conclusion that it had its seat in the nerve centers—an opinion substantiated by the fact that an injection of an extract from the spinal fluid of an affected dog resulted in the development of rabies by a healthy dog.

What Pasteur had done with the virus of anthrax he attempted to do with the virus of rabies. He developed a weakened culture which would constitute a vaccine.

Working constantly with dogs suffering from a disease that made their bite fatal was perilous work, but Pasteur never shrank from it. He developed his vaccine, and injected it into animals that had been bitten by rabid dogs. Invariably the animals recovered. Although these results pointed to success, Pasteur feared to use his vaccine on human beings.

On July 6, 1885, however, there appeared at his laboratory Joseph Meister, an Alsatian boy of nine, who had been bitten terribly by a mad dog. The boy's frightened mother begged Pasteur to attempt to save her son's life, and at last he consented.

Sleepless nights, the anguish of fear and constant watchfulness at the bedside were Pasteur's portion until the boy's recovery testified that once again he had prevailed over death itself. Three years later the Pasteur Institute was opened in Paris, and today there is not a country in the civilized world that does not support at least one similar institution. Thousands of people have been treated at these institutes. Through the treatment discovered by Pasteur, the death rate from this most terrible disease is reduced to less than one per cent.

Priceless Work

Of the money value of Pasteur's discoveries much has been said. His methods of curing anthrax, chicken cholera, and the disease of the silkworm saved France, so his contemporaries asserted, more than the whole cost of the war indemnity paid by France

to Germany in 1870. His work in the saving of human life is priceless. In the last half century the average span of life has increased 15 years, the infant mortality rate has been reduced one third, and the deaths from typhoid have been reduced four fifths. In no small measure are these improvements in public health the direct result of Pasteur's labors. Certainly his discovery of a cure for puerperal fever has saved the lives of thousands of mothers. Certainly the light he has cast on the field of preventive medicine and his development of vaccines led directly to the control of such diseases as typhoid.

Pasteur lived to enjoy in full measure the fame and honors that his work had earned. Long before his death—Sept. 28, 1895—the whole scientific world had been at his feet. Many monuments have been reared to him, but none will prove more lasting than humanity's grateful memory of the victorious fight he waged for all creatures against the hosts of death.

Young Inventor Aids Uncle Sam

How 18-Year-Old Postal Employee Ingeniously Doubled His Output

By H. H. Billany

Assistant U. S. Postmaster-General

NO BRANCH of the government service is more ready—I might say more anxious—to reward employees who evidence originality and ingenuity in the performance of their duties than the Post Office Department. Particularly is this so with regard to employees who suggest or develop improvements in mail-carrying equipment or in the machinery of the shops where the mail equipment is manufactured.

An interesting instance of this policy of the Post Office Department is furnished by a recent case in the mail equipment shops in Washington, D. C.

Antonio J. Lombardi, an 18-year-old employee of the mailbag repair department, for some time had been turning in time sheets that indicated he was performing about twice as much work as any other man in the shops ever had been able to do. Lombardi's particular job was the reaming of keyholes for mailbags.

Greenhorn Mystifies Experienced Men

His superiors in the shops could not understand how he, with only a few months' experience, could turn out more work than men who had been in the service for years. They began a quiet investigation. Experienced workmen, when questioned, asserted that it was impossible for one man to produce as much work as Lombardi claimed he was doing. They even suggested that there could be but one explanation—that his time slips had been padded.

Reluctant as they were to believe this, and failing to see what permanent benefit young Lombardi might derive from falsifying his records, the shop officials called the lad before them and bade him explain. Lombardi was embarrassed, but insisted stoutly that his time slips were entirely accurate. Pressed for further explanation, he at last led his questioners to his locker and drew from it a small block of wood on one side of which was carved a small half cylinder. This contrivance, he declared, was the secret of the unbelievable

amount of work he had been turning out. When the shop officials expressed their incredulity, Lombardi escorted them to his machine



Antonio J. Lombardi, 18-year-old post-office employee, who doubled his output in reaming keyholes for mailbag locks by inventing the simple block shown in inset, and so won official recognition

and inserted the block beneath the drill. The half-cylinder in the block fitted the curved end of the mailbag locks, permitting him to insert the lock with his left hand and work the reaming machine with his right simultaneously, instead of using both hands to perform each operation as other operators on the machines were compelled to do.

Lombardi explained that he had been accustomed to use the block at his work when he was unobserved. He hid it away in his locker at night, he said, fearing the

shop managers might reprimand him for making unauthorized improvements on government machines. When he had explained, he seemed to fear that he would be discharged for what he had done.

Instead, a report regarding Lombardi's device was forwarded to Postmaster-General New, who investigated its merits and ordered that a cash award be made to the lad for his invention and that he be given a certificate setting forth the reason for his reward.

And now Lombardi's device has been adopted by order of the Postmaster-General as standard equipment.

Combination Wrench Has Wide Range of Uses

A TOOL with an unusually wide range of usefulness is the combination pliers, monkey-wrench and pipe wrench illustrated here. It is quickly adjusted to fit various sized pipes, bolts, nuts, caps, nipples, and similar parts. It has a capacity for parts up to one inch square and 1½ inches round.

The tool is seven inches long, weighs about 12 ounces, and is made from a drop forging, machined, heat-treated and given a charcoal and gun finish.



Used as pipe wrench

With Webbed Gloves, Bathers Swim like Ducks

BATHERS who claim to be able to swim like ducks now can make good their boast by equipping themselves, not with webbed feet, but with webbed hands.

The webbed rubber gloves shown below do the trick. Swimmers who have tried them say that they make the process of moving through the water almost as easy as walking. Since the webbing displaces more water than the bare hands, greater speed is obtained. The gloves also protect hands from being shriveled by water.



These gloves displace more water than bare hands and increase swimmer's speed

What a Small Invention Did for Me

Prize Contest Announcement

READ Mr. Billany's inspiring story above. An ingenious idea won recognition from the postal authorities for young Lombardi. Perhaps you have had some similar experience. Possibly some simple device you have invented has helped you in your work, has won promotion for you. Tell us about it. Your letter should be based on personal experience. Remember that a simple story is likely to be the best.

For the best letter of not more than 400 words we offer these prizes: \$20, first prize; \$10, second prize; \$5, third prize.

Address letters to Invention Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City. Each letter will be considered by a board of editors, whose decision will be final. The competition closes October 20, 1923. Winning letters will be published in the February, 1924, issue. Contributions to the contest will not be returned unless accompanied by a stamped, self-addressed envelope.

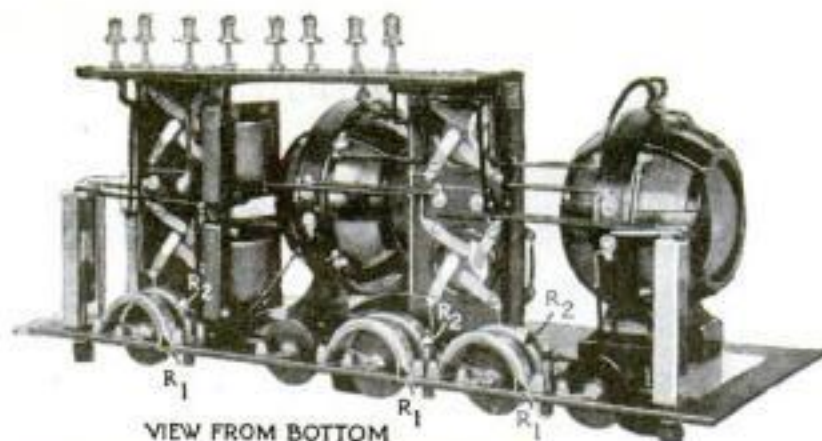
You Can Use Any Tube in This Set

TWO novel circuit arrangements are the features of the latest type of radio set, designed exclusively for the reception of broadcasted programs.

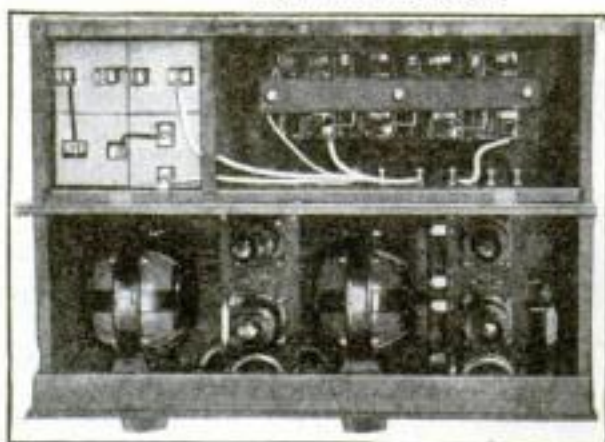
Two rheostats, one of the high resistance type and the other of the low resistance type, are used with each tube socket. By means of small pushbutton switches, either rheostat can be connected into the circuit of each tube socket. So, using adapters in the standard sockets provided with the set, the filament current requirements of any standard storage or dry battery tube can be met by connecting one or the other rheostat in the filament circuit tube.

One advantage of the arrangement is the possibility of using either all storage battery tubes or all dry battery tubes in the set, depending on whether it is to be used as a portable outfit or as a home receiver. It is possible also to use different tubes in the different stages of the set.

It is well known that some tubes are better than others for radio frequency amplifiers, while other types are better fitted for use as detector tubes, first stage audio or second stage audio amplifier tubes. With the new circuit arrangement one type of tube can be used for the radio



VIEW FROM BOTTOM



Arrangement of the new circuit viewed from the top (at left) and from the bottom (above), using tuned radio frequency and regeneration. R_1 and R_2 are 6- and 30-ohm rheostats respectively

frequency amplifier, another type as the detector, another type for the first stage of audio, and still another type for the second stage. In addition, all tubes of one kind can be used, if desired.

The novelty of the actual wiring in this set lies in the manner in which tuned radio frequency plus regeneration is accomplished.

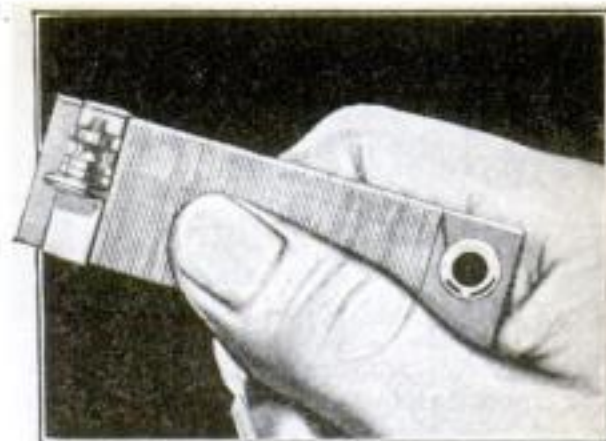
While there are several adjusting controls, there is only one adjustment that is critical, so the set can be considered a one-control set. It can be operated without an aerial, but it gives better results when a good indoor or outdoor aerial is used.

Loudspeakers and Phones Tested by Phonograph

AN INGENIOUS method of testing the comparative merits of radio loudspeakers or head phones by means of a phonograph has lately been devised by Benjamin F. Miessner, a radio engineer of Newark, N. J. The phonograph music is transformed into electric currents by a special type of microphone actuated by the reproducing needle.

The loudspeakers or phones to be tested are connected with the instrument, and a quick change switch permits the musical current to be transferred from one to the other in a fraction of a second. The comparative reproducing qualities of the apparatus under test are apparent instantly. The test is said to be more satisfactory than ones conducted with a radio receiver, because the volume and quality of phonograph music is constant, whereas radio signals may vary continually.

The device has been made portable.



This New Resistance Unit Is for "Peanut" Tubes

WHEN operating the new dry cell tube that consumes .06 amperes, it is necessary to use a larger resistance than the regular rheostat in order properly to cut down the voltage of the three dry cells used in series to provide the proper operating current. For this purpose the resistance unit pictured above recently has been put on the market by a rheostat manufacturer.

By placing it in series with the regular rheostat and filament, the resistance of the circuit can be varied.

This unit also will find numerous applications in the experimental laboratory.



Radio for the Steeplejack

RADIO enthusiasts seem to be wherever there is air and a place to stand or sit. This picture shows how radio followed Michael Bourke, steeplejack carpenter, to dizzy heights in order that his noonday meal might be spiced with melody.

Radio to Join Ford Holdings

THE vast property holdings of Henry Ford, scattered throughout the world, are to be unified by radio. A large broadcasting station, strong enough to communicate across the Atlantic, is being constructed at the River Rouge Ford plant. This latest step results from the successful operation during the past eighteen months of radio and wireless communication between Ford plants throughout the United States and Ford headquarters in Dearborn and Detroit.



Radio Panels from Records

DANCE records of yesteryear that clutter your cabinet need not be thrown away if you are a radio enthusiast. They make excellent radio panels, being of excellent insulating material and easily drilled.

The illustration shows two sets thus fashioned from discarded records. The top view of the panel, at the left, shows the switch points for tuning, the detector and binding posts for phones and the aerial and ground. The bottom view shows the tuning coil and the variable condensers. The completed set is mounted on a round cardboard hatbox, a neat crystal set.

Around the Radio Circuits

with Jack Binns

Third Article: Tuned Radio Frequency and Neutrodyne

This is the last of a series of three articles in which Jack Binns, our radio editor, reduces apparently intricate radio circuits to first principles

SOMETHING about the name, "Tuned Radio Amplification," gives it an air of mystery. To the average fan the name conjures up visions of controls and adjustments that only the expert can master.

To many who have dabbled with the ordinary form of transformer coupled radio frequency amplification, there seems to be no justification for "tuned radio." They cannot see why any one should add adjustable circuits where a fixed circuit apparently will work with supreme satisfaction.

Simplifying "Tuned Radio"

To clear up this question, and to show that "tuned radio" is by no means as complicated as it seems is my purpose in this article, the third of a series designed to explain various types of circuits by tracing their evolution from the original basic hook-up.

Of course, it is an easy matter to say that a thing is not difficult, but it is quite another matter to prove that assertion.

In this case I shall attempt to prove my contention first by considering the very simplest circuit as a means of illustration.

If we place a variometer in series with an aerial and ground, then place a crystal detector and a pair of telephones across it, we shall have a complete radio receiving set that will work over a distance of at least 25 miles.

Let us analyze this circuit and its operation. When we turn the rotor coil of the variometer to a certain position, we hear the speech or music that is coming from the nearest broadcasting station.

Naturally the wave-length range of such a receiver is extremely limited, and will be determined by the maximum and minimum inductance represented by the range of settings on the variometer.

How does such an instrument, so very simple in itself, work satisfactorily? When we have clearly understood this, we shall be able to comprehend the action that takes place in "tuned radio."

In the first place, the electromagnetic waves that surge through the ether from the aerials of the broadcasting station consist of an alternating current wave with a tremendous high frequency. In other words, electricity is passing through the cycle, negative to positive,

and back to negative again at a rate of about a million times a second.

This terrific rate of change is referred to as "radio frequency" because it is far above the range of variation that comes within the audible scale. A wave that is alternating at such high frequency introduces the phenomenon of electrical resonance, and in

that there must be a certain balance between capacity and inductance for every wave length—in other words, for every frequency. All such circuits that combine inductance and capacity are called "oscillatory circuits."

"That is all very well," you may say; "but where do you get the capacity with only a variometer?"

The answer lies in the fact that in every piece of wire there is a quality known as "distributed capacity." If we wind this wire in the form of a coil, and put insulation around the wire, we shall find an appreciable amount of capacity in the circuit represented by the winding.

Variometer Will Help

In this case we obtain our tuning by varying the amount of inductance in the circuit, without interfering with the total capacity of it. Such a method of tuning is practical and efficient. Under such circumstances a variometer is a very efficient tuning instrument, provided too much is not expected from it.

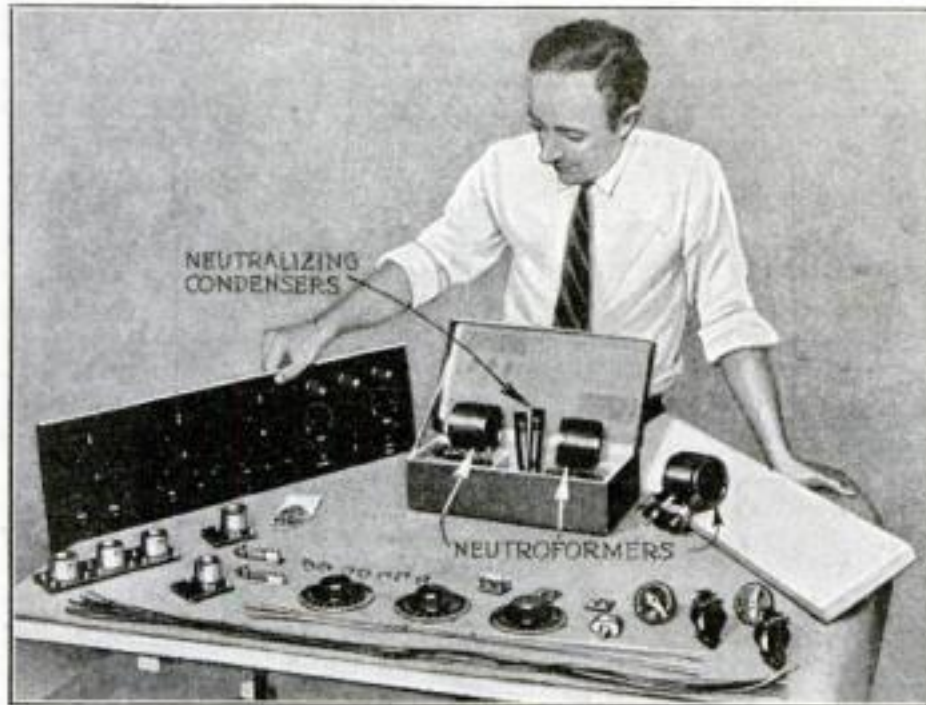
After we have grasped the underlying principles in the action of an oscillatory circuit, we can proceed to an explanation of the difference between transformer coupled radio amplification, and "tuned" radio amplification.

If we impress an alternating voltage across the grid and filament of a hard vacuum tube, an equivalent of the voltage will be reproduced in the plate circuit, provided the right constants exist in the plate circuit. There will be this difference, however—the reproduction in the plate circuit will be many times stronger because of the amplifying characteristics of the tube itself.

Radio frequency transformers are designed to pass this amplified current along to the next tube for further amplification. In the very nature of things these transformers are designed to cover a fairly large wave-length band. In other words, they must cover a wide range of frequencies, otherwise separate transformers would have to be inserted in the circuit for each individual broadcasting station.

This being the case, the transformer will be more efficient on the frequency to which it is nearest in resonance than it will on any of the other frequencies it passes. This is a disadvantage that in practice is offset by the fact that the transformers are automatic in their action, and do not require adjustment.

It is in this respect that "tuned" radio amplification is really the most



Complete outfit of parts for building a radio receiver using Prof. Louis A. Hazeltine's neutrodyne circuit, shown in diagrams on page 62. Because of the difficulty of winding the three neutroformer coils properly and of making the small neutralizing condensers, manufacturers now are building these parts complete for amateurs who like to make their own sets

order to record it we must have a circuit that is capable of resonance.

The primary requirements of such a circuit are inductance and capacity. The former is obtained by means of a coil of wire, the latter by means of a condenser.

The remarkable thing about the circuit is

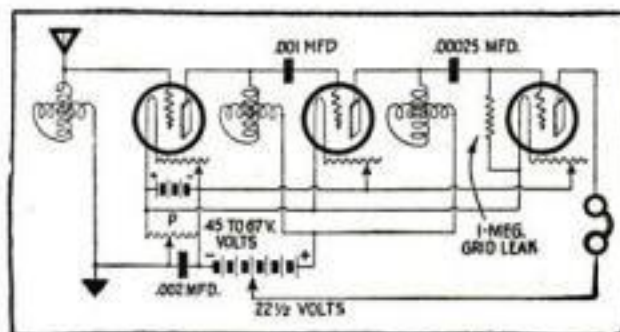
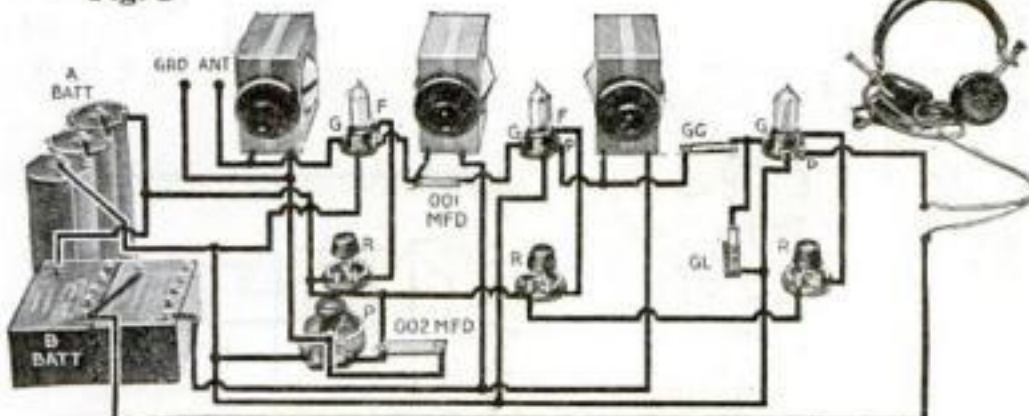


Fig. 1



Tuned radio frequency circuit: R signifies rheostat; P, potentiometer; GC, grid condenser, .00025 mfd.; GL grid leak, 1 or 2 megohms. Complete constructional details of a tuned radio frequency unit that can be used with any standard set will be given in next month's Home Workshop Department

satisfactory, because what we really do with such a system is to tune each of the circuits into resonance with the wave we are receiving. The result is that we obtain the maximum possible amount of amplification, the maximum transfer of energy from one stage to another, and the maximum amount of selectivity.

The ability to obtain maximum selectivity is apparent. Each stage acts as a sieve, allowing only those currents that are in exact resonance to pass through, and stopping the others. The drawback, of course, lies in the increased number of adjustments necessary.

Now, if we examine various diagrams of simple receivers, we shall observe that in addition to the variometer circuit described in the beginning of this article, we can have a double circuit that can be quite an elaborate affair. For example, it can consist of a variocoupler with a variable condenser in series with its primary winding, and another condenser across its rotor winding. Under these conditions it will have four different tuning elements: First, the setting of the series condenser; second, the number of turns of wire put in use in the primary; third, the degree of coupling between the two coils; and, fourth, the setting of the second condenser.

Similarly the interstage coupling of a radio frequency amplifier can be made simple or complicated, as desired. The more adjustments used, the more accurate will be the resulting tuning, and the more expert will be the handling required. In practice, a multiplicity of adjustment is not necessary. In fact, a variometer in each of the circuits will be sufficient, provided the variometers are designed to cover the wave length band to be received.

Difference Lies in Grid Circuit

Such is the basic system of "tuned" radio amplification, a circuit diagram of which is shown in Fig. 1, on page 61. A glance at the diagram reveals that for all practical purposes the method of coupling the different stages is almost the same as that employed in audio frequency amplifiers.

The main difference lies in the grid circuit when a plain variometer is used. In this case the B battery is joined to one side of the variometer. We could not connect it direct with the grid, for if we did so, we should be impressing the full B battery voltage across the grid and filament of the succeeding tube, preventing operation.

This difficulty is overcome by inserting a by-pass condenser in series between the plate side of the variometer and the grid of the next tube. This condenser is a fixed one, and will readily pass the radio frequency currents in the circuit, at the same time effectively stopping the direct current of the B battery from reaching the grid circuit.

If more than one stage of "tuned" radio is employed, and the variometer type of coupling used, it will be found that every variometer actually in a plate circuit can be calibrated for wave length, and settings made accordingly for reception

from any station. To accomplish this, the dials must be fitted carefully to the shafts, so that relative positions of the dial and rotor will remain unchanged.

Under these circumstances, tuning can be accomplished in the same manner that a safe is opened—by means of a combination. The method of procedure is as follows: Set the plate variometers in the same position, and make the final tuning with the

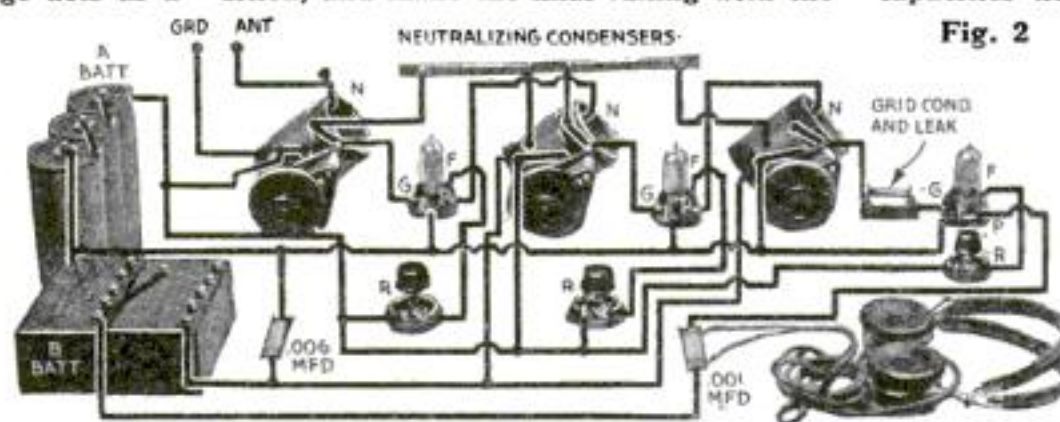


Fig. 2

destroying the troublesome capacity effects.

Having achieved this important result, Professor Hazeltine was able to take advantage of other known laws until he obtained a step-up ratio in the windings of the interstage transformers. These transformers have four times as many turns of wire on the secondary as they have on the primary. The result is that in transformation the secondary voltage is stepped up four times, which, of course, gives further amplification.

Another important feature of the transformers is the novel method of tuning them into resonance with the incoming wave.

This is done entirely by means of condensers placed across the secondary coils, with the result that the number of controls is reduced. Here the inventor has taken advantage of the laws governing coupled coils. If this coupling is extremely close, the total inductance of both coils will exist in each circuit, so that, while there are actually but 15 turns of wire in the plate circuit, the total amount of inductance will be equal to the total in the transformer.

This novel adaptation of electrical laws permits an efficient coupling of the different stages, and makes it unnecessary to insert any by-pass condensers in the grid circuit of the amplifiers.

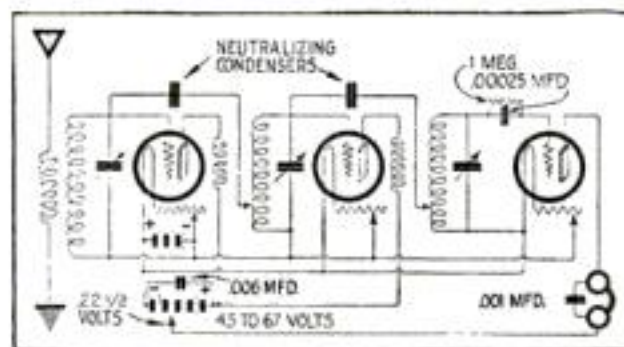
An Important Point

An important point to remember in the neutrodyne circuit is that the secondary coil must be wound on the outside of the primary coil. The object is to screen away some of the coupling capacity that otherwise would exist between the primary coil of one stage and the secondary circuit of the preceding stage. Another point is that the transformers must be set at an angle of 45 degrees, at least six inches apart from each other, in order that they will not be in the electromagnetic fields of each other.

These, however, are only variations of the basic system of "tuned" radio. A glance at the diagrams of the two systems will show how both are much alike, and it will bear out the fact that I have tried to emphasize in this series—that all circuits have a definite reason for existence, and that all are based on the same fundamentals.

The third system (Fig. 3) shown on this page is a simple "tuned" radio reflex circuit. In the September article I explained in detail the reflex system. The circuit shown here is unquestionably the simplest of the reflex adaptations. It is one with which we have experimented extensively and which has given very good results both as a distance getter and a volume giver.

† Next month Jack Binns will describe the various types of vacuum tubes used in radio.



The neutrodyne circuit: R signifies rheostat; P, potentiometer; N, neutrodyne coils. Note positions of neutralizing condensers

aerial variometer. When stations have been heard, record the reading of the dials on a chart. The same stations can be found again in the same recorded positions.

Explanation of this simple tuning scheme brings us to a consideration of the most remarkable invention of the year—namely, Professor Louis A. Hazeltine's neutrodyne principle. This system is simply tuned radio frequency amplification, with the squeal removed.

In my article last month I pointed out just how regeneration was present in radio frequency amplification. Unless the transformers are correctly designed, this regeneration is a distinct disadvantage and prevents clear reproduction.

Professor Hazeltine's very ingenious invention eliminates this disadvantage by adopting a well known principle that two

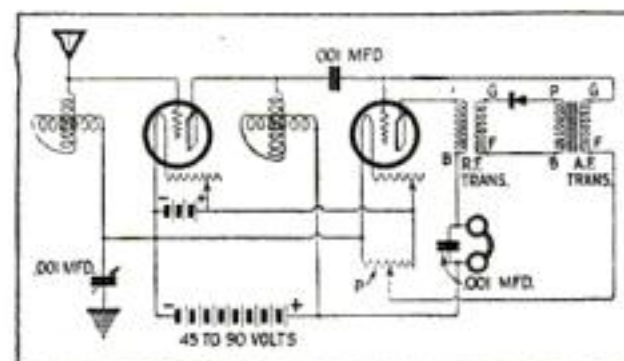
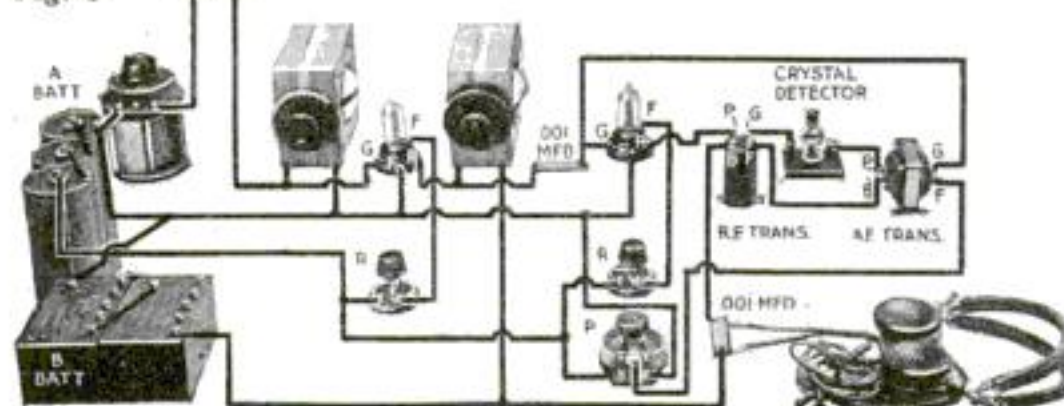


Fig. 3



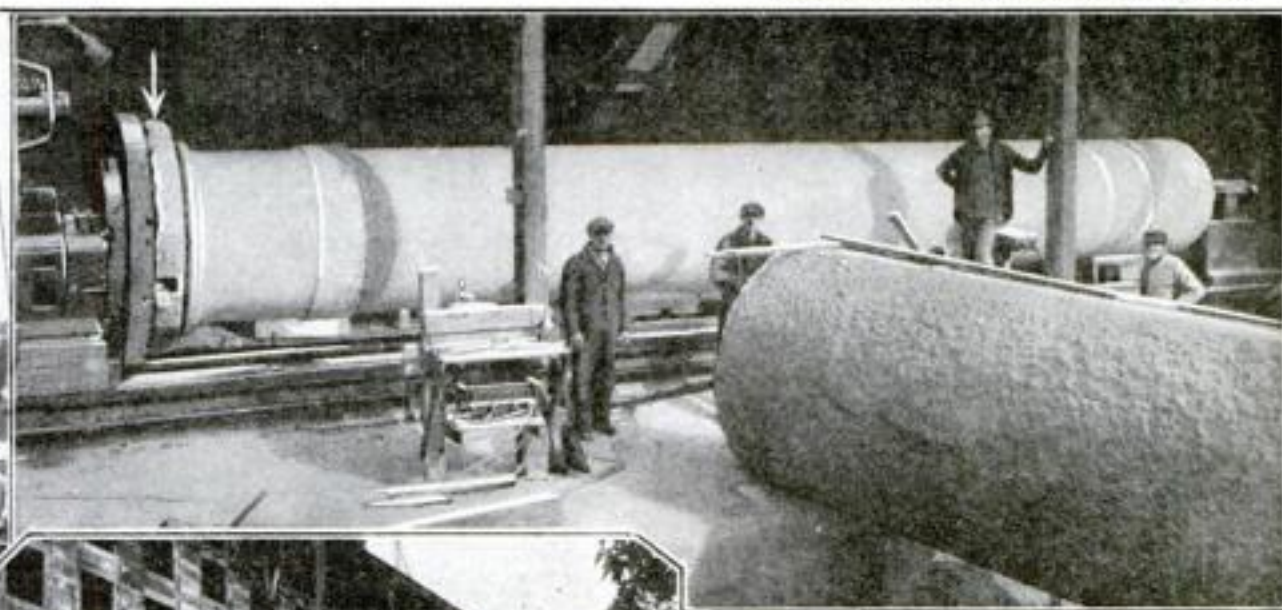
Combination of tuned radio frequency and reflex circuit: R, rheostat; P, potentiometer

Largest Cut Stone Columns of Modern Times

Photograph courtesy Travelers Insurance Co.



Rigging apparatus required by the great size and weight of the columns



A "trimmed" block in the foreground, and a column on the lathe

THE largest single blocks of cut stone quarried in modern times, 36 in number, were erected recently as the columns of the new South Office Building at Harrisburg, Pa. Each of these blocks was five feet in diameter and 33 1/2 feet long, and each weighed, in the finished state, approximately 40 tons.

It is said that the ancients, notably the pyramid builders of old Egypt, quarried and transported still larger blocks.

These modern columns are of Indiana colitic limestone. The roughly hewn blocks from which they were cut weighed 90



A column being hoisted to its pedestal (see arrow) on the new South Office Building at Harrisburg, Pa.

tons each. These rough blocks were trimmed, or "scabbled," by hand tools into a cylindrical shape. By this process the weight was reduced to 75 tons. The final shaping was done on a lathe, specially constructed with considerable ingenuity to accommodate the unprecedented size of the blocks.

The finished columns were taken on flat cars from Indiana to Pennsylvania, their size and weight making necessary the employment of unusual rigging apparatus when they were lifted into place. It is worthy of note that these columns were quarried, delivered, and erected without damage to property or persons.

Mechanical Marvel Blows Incandescent Bulbs

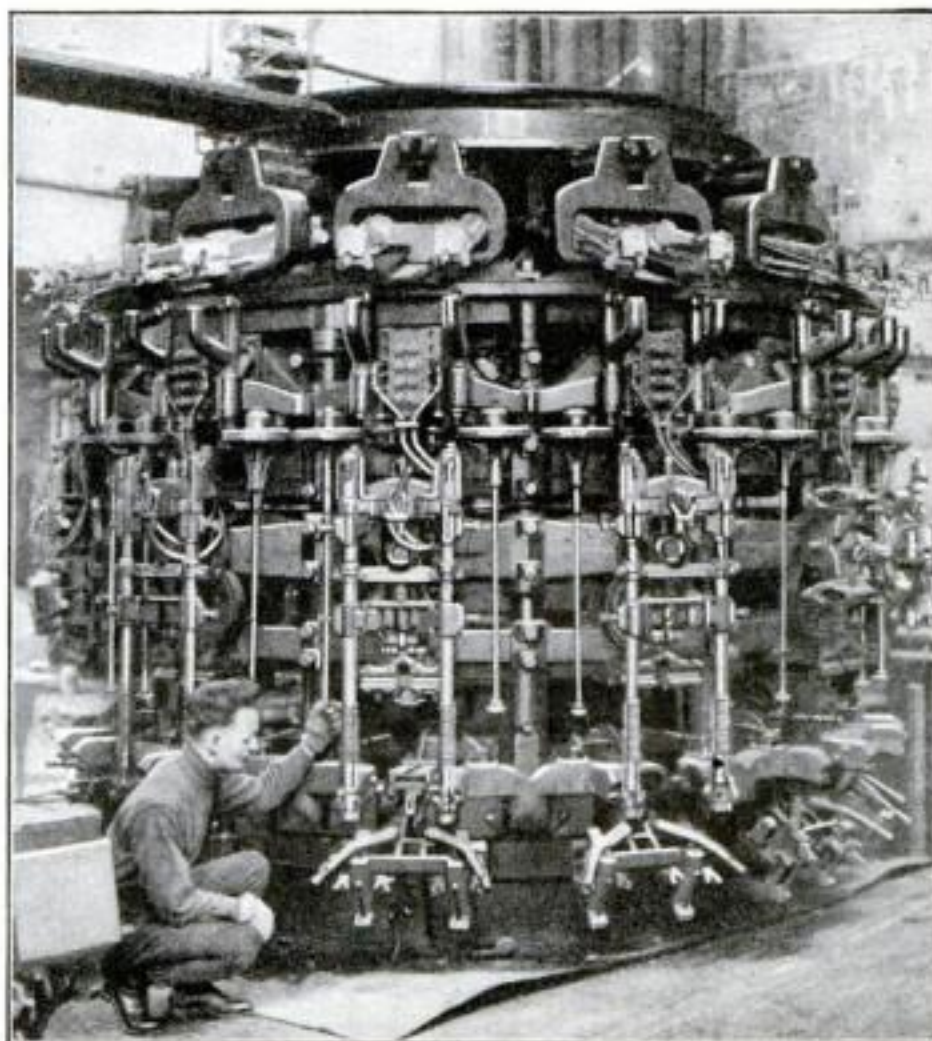
THE remarkable machine shown here, recently installed in the National Lamp Works of the General Electric Company at Cleveland, Ohio, performs all the operations of blowing incandescent lamps, having a capacity of 50,000 bulbs a day. The machine has as many as 14,000 parts.

Twenty-four great arms at its sides reach out and take the molten glass from a tank. A small, sharp knife trims the bubble of glass to the proper size. Compressed air then inflates the glass slightly, and in this condition it is placed in a mold, where compressed air shapes it properly against a

steam cushion. The process is incredibly rapid, perfectly formed bulbs being deposited on a platform an instant after the arms have taken the molten glass from the tank.

An annealing machine, to which the lamps are carried by a conveyor, then automatically removes minor imperfections if its vigilance discovers any. The bulbs are inspected by hand at the end of their journey.

The infinite precision with which so many of the operations involved must be performed makes the development and successful operation of the machine the more remarkable.



This complex mechanical giant, with 14,000 parts, blows 50,000 incandescent light bulbs a day, a task involving infinitely precise operations. Compressed air blows the bulbs



This Three-Wheeled Truck Reduces Upkeep Costs

A THREE-WHEELED electric truck that is readily handled in confined spaces and can be turned about in the space on which it stands, has been developed by a Chicago firm.

The truck is driven by the front wheel, inside of which the motor is mounted. The motor pinion engages a circular rack on the interior of the wheel. Steering is accomplished by turning the front wheel, and the connection between the steering column and the wheel is made by means of a pinion on the lower end of the column that engages a circular rack.

It is claimed that the motor and drive mechanisms have been reduced to the simplest form through the elimination of steering knuckles, differentials, chain drives and auxiliary parts. This elimination also reduces maintenance expense and time and labor loss.

The truck was developed originally from a horse-drawn truck owned by the company, for which some use was sought. The motor wheel and battery were attached to the truck and experiments evolved the machine here shown.

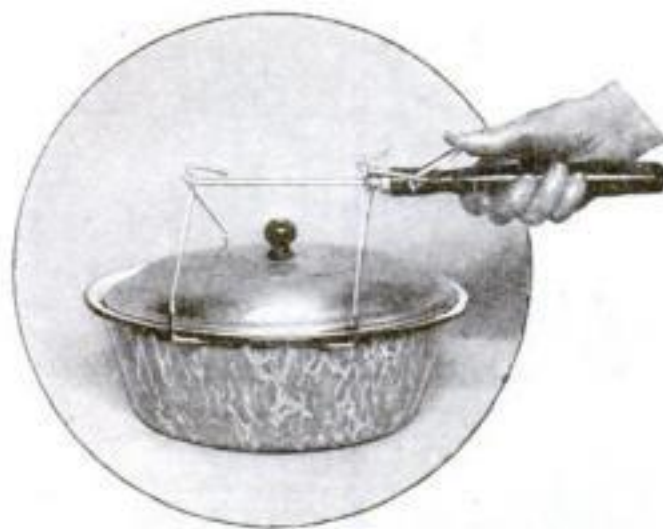
Useful Ideas for Home Convenience



In every kitchen where space is at a premium, this combination kitchen cabinet and refrigerator will be found unusually serviceable. The cabinet is clamped to the top of the refrigerator. Either part of the combination may be obtained separately—icebox or cabinet



This rapid cruller cutter contains a series of sharp knife edges so arranged as to cut the dough in cruller shapes. One complete revolution of the roller cuts 30 uniform crullers



Pots and pans, no matter how hot, may be lifted by means of the device shown above. A lever operated by the thumb spreads the wire wings that grip the edges of the pan



An automatic broom holder has an arrangement of two mechanical fingers, tipped with rubber pads, that tightly grip the broom handle when it is inserted



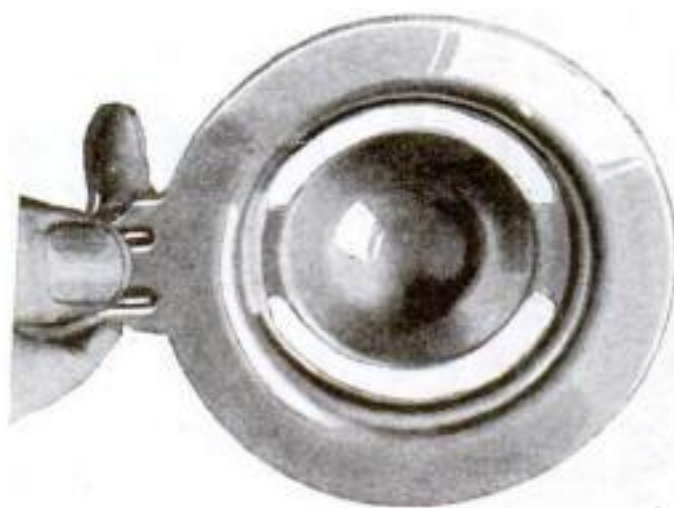
A novel ash dust remover consists of a smoke outlet pipe terminating in a cover that fits the top of the ashcan. This cover has a slanting chute into which the ashes are shoveled. The outlet pipe runs to furnace smoke pipe



Equipped with three sets of powerful jaws, a new universal opener is said to remove caps of all sizes. An extension of one of the jaws is a bottle opener



Concentrating the force of the water, this sanitary flusher drives waste down the pipes of sink or bath



This handy aluminum egg separator is placed over a cup. When the egg is broken into it, the yolk remains in the cup-shaped center, while the white runs through the circular slits into container below



Designed to remove smoke and cooking odors from the kitchen, this electric ventilator fan can be installed easily in the top of a window. It has a capacity of 500 cubic feet of air a minute

Cooking Better Food with Less Gas

Uncle Sam's Tests with Standard Burners and Ovens Show
How to Save Money and Enormous Quantities of Heat

WOULD you, husbands of America, like to save from 25 to 50 per cent on your household gas bills?

Would you, wives of America, like to help in the saving and at the same time see that the meals you cook, or whose cooking you direct, are prepared scientifically and efficiently?

If so, look to your kitchen gas range and learn its ways; for there lies your chance of achieving both these goals.

Study Your Stove

Your gas range is a mechanical device, not a particularly complicated one, it is true, but still possessing with all other mechanical devices a common characteristic—it can be used correctly and it can be used incorrectly.

Recently in her work as assistant chief of the Office of Home Economics, United States Department of Agriculture, Dr. Minna C. Denton has conducted numerous tests of gas ranges, and as a result of those tests, is in a position to lay down certain easily understood rules for the correct and economical operation of a range. Some of these rules are outlined as follows:

The first thing to be investigated is the flame you use. The hottest flame—which means the flame that will do the most cooking with the least expenditure of gas—is blue; not red, nor yellow, though flames of these colors may appear much hotter. A blue flame—with a tiny tip of yellow—may be obtained by turning the air adjustment device that you will find on the pipe leading from the gas cock to the burner—a device most people neglect entirely.

The Blue Flame Is Important

Different ranges will require different methods of adjustment to obtain the proper flame. You will have to experiment to determine how the best flame is to be obtained on your stove; but keep at it until you get the quality of flame described above, for it is a matter of prime importance.

When you have made this adjustment, the next thing to consider is the burner you are to use. The largest burner on your stove consumes probably 50 per cent more gas than the next smaller one, so it is manifestly absurd to use this big burner unless you are cooking a large quantity of food in a large pot.

As a general rule, use a burner of a size that will not permit the flames to lick around the edges of your pot or pan.

Don't fail to use the simmering burner—the smallest on your range. Many housewives never light this burner, which is wonderfully useful in keeping things boiling once they



Tests conducted in Uncle Sam's Office of Home Economics at Washington, D. C., showed that an interlining of asbestos between oven walls will conserve enormous quantities of heat while cooking a meal

are started on the larger burners. Its use brings about a considerable saving in gas.

Select a stove with burners that will lie not more than from one to 1½ inches below the bottom of the pan. Long flames use much more gas than short ones to produce the same effect.

Be sure that burners are clean and jets kept open.

When food has started to cook, turn down the flame. A high flame is uneconomical and will result in little additional speed in cooking.

Your oven, too, unless it is properly constructed, maintained, and operated by

you, is a constant source of waste. Examine it to be sure that it is tight and doesn't permit the escape of heat. Interlining the walls of the oven with asbestos will conserve an enormous quantity of heat; but, whether you have an oven so constructed or not, be certain that all cracks, especially about the edges of the door, are closed.

Whenever possible, bake at low temperature. You will find that the difference in time between a "fast" oven and a "slow" one will not compensate you for the difference in gas consumption. There are several oven thermometers on the market that will tell you at a glance the exact temperature at which you are baking.

Other Types of Cookers

A fireless cooker will save gas, but only if used properly. Do not overheat the stones. Certainly there is no economy in using as much gas to heat the stones of a fireless cooker as you might use to perform on your stove the same cooking operation.

Pressure cookers also are useful in reducing gas consumption, especially in the preparation of tough meats, vegetables, and cereals. The hooded fireless burner, made by some manufacturers, also is a fuel saver.

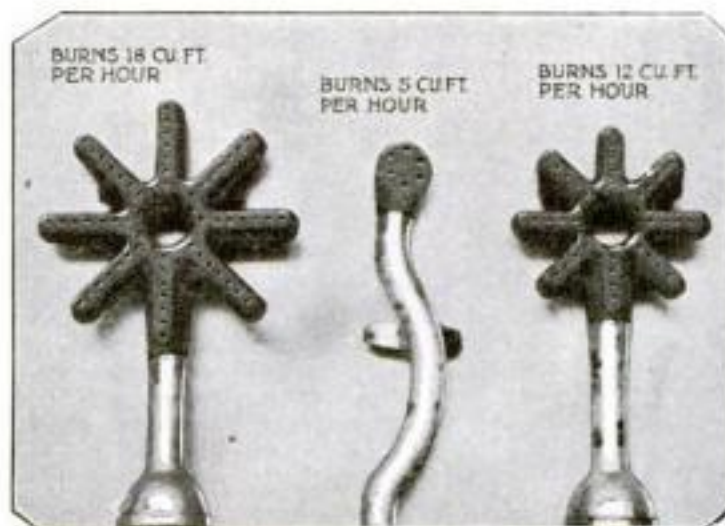
The tests on which Doctor Denton based these rules were entirely practical. Using well-known brands of gas ranges, she actually cooked meat, vegetables, and puddings, baked bread and biscuits, boiled water; in fact, performed with the ranges under test the same operations that housewives all over the country are performing every day. Records were made of the gas consumption and of the time taken to complete each task of cookery.

The results of the tests are the rules here outlined. Follow them, and you will find that they will give a real saving in gas, labor, and food that is properly prepared.

Many Uses for Old Corks

OLD corks can be used in many valuable ways about the house. Spots and blemishes on window glass nearly always will disappear if rubbed with a dry cork. Moistened with turpentine, it will remove marks from hearth tiles or white glaze bricks. Rust spots on metal can be removed by cork dipped in paraffin; spots on linoleum by cork dipped in gasoline. Burnt marks on pie dishes and plates will vanish if treated with a cork dipped in wet salt.

An effective foot warmer for cold winter nights may be made by cutting corks into small bits, filling a flannel bag with them, and heating for 10 or 15 minutes.



Typical burners of three sizes. The tests showed that the largest burner consumes 50 per cent more gas in cooking than the next smaller one

Wild-Animal Hunters Save U. S. Millions

Champion, at 70, Has Bagged 500 Lions



A government hunter bringing in a carload of Arizona coyotes

WAS there ever a small boy who did not dream of happiness in the wilderness, surrounded by perils, but downing with each bang of his trusty rifle another leaping, roaring lion?

Ben V. Lily, champion hunter of the United States Biological Survey, was such a boy. And he has just celebrated two anniversaries, one his seventieth birthday and the other the completion of 60 years as a big game hunter.

Wild Beasts Are Plentiful

Lily carries on his story-book career, not in the jungles of Africa or India, but right here in the United States. We might well imagine that development of commerce and the practical application of science in America have eliminated the dangers to life and property from wild beasts. Yet, with the recording of Lily's seventieth birthday the United States Biological Survey chalked up to his credit the bagging of his five-hundredth mountain lion. At the same time official estimates show that his campaigns against predatory animals in New Mexico actually have saved stockmen of the Western states several million dollars a year. Lily hunts with dogs and on one occasion is said to have worn out four packs before bagging his quarry. Another time he trailed a bear 400 miles and killed it.

The story of Lily's remarkable career recalls the fact that there is still a "Wild West," and that even in these days of comfort and security constant battle is necessary against the depredations of savage beasts.

Eighty thousand predatory animals was the bag of Uncle Sam's riflemen last year. They shot, trapped, or poisoned 687 timber wolves, 173 mountain lions, 114 bears, 2827 bobcats, and 77,185 coyotes.

Before the army of government hunters was enlisted, the tooth and fang tribute collected annually by the predators amounted to \$30,000,000. In seven years the sharpshooters have killed 380,000 stock-



Captured—a Captain Kidd of the Western plains. Here is a typical prairie wolf, stealthy and wise, trapped in his crafty search for livestock prey

killing beasts, and thus are given credit for saving \$35,000,000 worth of domestic live stock. They are modern minute men, for they are always ready to answer the call of stockmen and ranchers who report the presence of obnoxious freebooters. There are 266 of them in the Western states.

Among these hardy men, the heir apparent to Lily's title as world champion is Charlie Miller, who killed 20 mountain lions in the first two months of this year. The value to stockmen of this big bag is

shown by the government estimates that each adult mountain lion destroys at least \$1000 worth of live stock every year. To Miller last year went the credit of poisoning a wolf near Flagstaff, Ariz., that had eluded hunters for seven years and terrorized flocks and herds, causing a loss of more than \$10,000.

Some Record Bags

Other government hunters have made record kills in the campaign against predatory beasts. In three hours Lloyd Thompson, a government hunter stationed in Montana, and his dog rounded up and killed five mountain lions.

W. E. Cozzens, of Idaho, has won fame as a wolf hunter and has proved himself quite as cunning as the animal he seeks. He dresses in white and glides about on skis during the winter. He steals up on the wary wolves before they detect his presence. Last winter he accomplished the feat of shooting five wolves in a pack in this manner without a miss. Cozzens has bagged 80 destructive wolves in the last few years.

One of the 30 government inspectors in the 15 Far Western states tells of a government hunter who bagged five mountain lions and a bobcat in three days.

"Some wild animals kill for blood lust only," says W. H. Caywood, one of Uncle Sam's best wolf hunters. "A Rocky Mountain wolf, for example, kills just for the love of killing. Once I saw a pack of wolves drive a dozen cattle over a precipice out of pure devilment."

Coin Clock Saves Money when You Wind It

FOR the benefit of people who haven't learned how to save money, a Cleveland manufacturer has devised an ingenious clock, which requires winding every 24 hours, but which cannot be wound unless a nickel, a dime, or a quarter is dropped in a slot to release the spring.

The clock is small, 2½ in. in width, but, if its possessor keeps it running, its capacity is sufficient to add many dollars a year to his savings account.

The clock has found wide use among banks of the Middle West, which use them to encourage thrift on the part of new depositors.



COIN HERE



Above: Setting traps for coyotes. At the left is Ben V. Lily, American champion big game hunter who at the age of 70 has killed 500 mountain lions

Can Your Jaws Lift Jack Dempsey?

By Arthur D. Black, M.D., D.D.S.

Dean of Northwestern University Dental School

POSSIBLY you are aware that the human jaw is very strong. You have seen circus performers swinging from trapezes or raising enormous weights by the grip of the teeth. But do you know that the muscles of your own jaw, developed merely by the necessary work you perform in chewing your food, possess power enough to lift from the ground a man as large as Jack Dempsey?

Tests of the jaw power of many thousands of persons offer some surprising facts regarding the strength of the average human jaw. A person of normal strength and with useful teeth can exert more pressure between his back teeth than he can produce by any other part of his body. The bite of the jaw is stronger than the grasp of the hand, the pressure of one hand against the other, or the grip of the knees. It is greater than the weight of the whole body of any but exceptionally heavy persons.

The average jaws possess a biting power of 171 pounds, the jaw strength of thousands of persons examined varying between 25 pounds and 260 pounds. The figure of 260 pounds does not, however, necessarily represent the maximum power of the jaw.

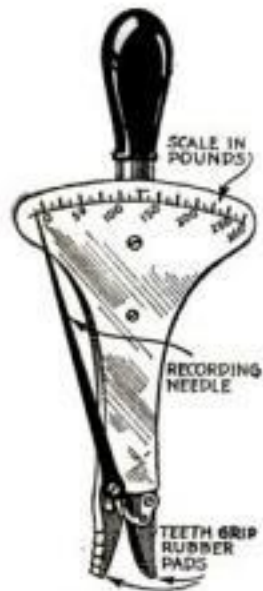
The instrument by which the power of the human jaw is measured, called the gnathodynamometer, is constructed to register no higher than that figure. Doubtless many persons can bite as much as 300 pounds.

Just how great a force 260 pounds is can be realized when I say that it is equivalent to the greatest weight the average man can lift from the floor with one hand, using his back, legs, and every other muscle to aid him.

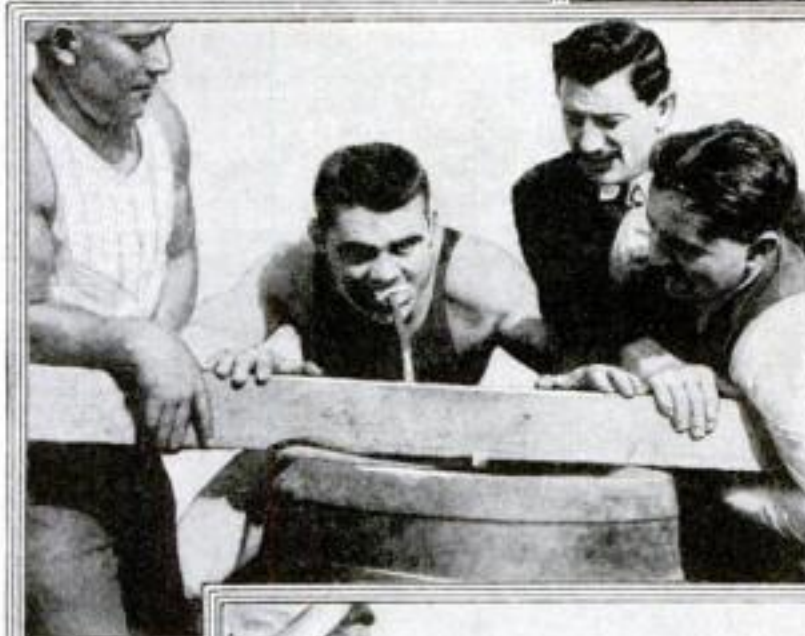
The strength of the bite as registered on a recording instrument depends not so much upon the muscular power of the person being tested as upon the condition of his teeth. This condition depends in turn upon the habitual use of the teeth. Wrong advice that most of us receive early in life is responsible for the fact that we shrink from attacking with our teeth hard substances that would yield to them readily.

A normally healthy child will attempt to chew almost anything that appears to be edible. It will crack nuts and gnaw on hard candy and its teeth will suffer no harm. On the contrary, the tissues supporting the teeth will be strengthened and hardened as those of an animal are hardened from chewing on bones and other hard substances. Misin-

formed elders, however, will warn the child against this instinctive use of the teeth for the purposes for which they were designed. The result is that the child acquires fear of biting on hard objects, and its teeth, lacking the exercise they need, do



This device measures jaw strength



Gus Lessis, strong man of Brighton Beach, N. Y., bending and breaking a thick iron spike with his teeth. The spike was embedded eight inches in a wooden beam

How Much Power Do You Use when You Eat?

"THE toughest beef will yield to a grinding force of from 70 to 90 pounds," says Doctor Black. "Mutton may be chewed with a force of between 30 and 45 pounds. Roast veal requires from 35 to 45 pounds, pork from 30 to 35 pounds, corned beef the same, and broiled ham from 40 to 60 pounds."

not receive the thorough scrubbing which results from vigorous mastication.

I have seen many persons, who, accustomed to chewing only on soft foods, have registered a bite of only 30 pounds under test. A change of diet, which included a fair proportion of hard foods, worked wonders with these persons. Within a month their teeth were capable of exerting



© Keystone

The acrobats' teeth hold organ and player

a pressure of 100 pounds, and three or four months of the treatment raised the strength of their bite to 150 pounds.

Years ago in the West, hazel nuts with tough shells, requiring between 150 and 200 pounds pressure, grew wild, and people cracked them with their teeth. Those same

nuts are cultivated and soft-shelled now, requiring only half as much jaw force. Yet today few people would dare attack them with their teeth.

All of us should use our teeth freely on hard foods. It is a commonly expressed fallacy that teeth which have been filled are to be spared in chewing. This is not true. If the dental work has been done properly, the filling will be more than equal to withstand a pressure of from 125 to 150 pounds. This is the greatest force the jaws ordinarily will be called upon to exert.

The toughest beef will yield to a grinding force by the teeth of from 70 to 90 pounds. Better cuts of beef may require as little as 45 pounds pressure from the

jaws. Mutton may be chewed with a force of between 30 and 45 pounds. Roast veal requires from 35 to 45 pounds, pork from 30 to 35 pounds, corned beef from 30 to 35 pounds, and broiled ham from 40 to 60 pounds. Among meats, cold boiled tongue can be chewed with the least expenditure of jaw energy, between three and five pounds sufficing.

To those who may fear to break their teeth by biting on hard substances, let me say that, provided their teeth are in good condition, they will not be harmed by small bones or stones, birdshot or similar materials that accidentally may get into the food. Tests conducted on a specially constructed dynamometer show the teeth to be much stronger than any of these materials.

Freshly extracted teeth placed in this machine resisted much stronger pressure than stones, metals, and other substances which the average man would regard as being considerably harder than his teeth.

Oiling and Greasing Your Car

Costly Repair Bills, Even Accident or Death, May Be Penalties of Neglect

By F. A. Platte

Instructor, Department of Physics,
Columbia University

RECENTLY I found a neighbor stalled by the roadside. His machine was in the ditch. His clothes were covered with mud. He was white and shaking.

"The steering gear broke and I was nearly killed," he said. "Only the soft mud of the bank saved me."

I went over and looked at his car. A steering knuckle had broken.

"If you had oiled your car properly, this never could have happened," I told him.

"Oil?" he said in surprise. "What has oil to do with it? Besides, I filled my crankcase just before I left the garage. Even now the gage shows it nearly full."

I picked up part of the broken knuckle. It had worn thin. "When did you oil your steering apparatus last?" I asked.

"Oh, I never oil that," he replied.

That neglect nearly had cost him his life. Because of the lack of oil, the constant friction on the steering knuckle had worn it thin. It had snapped suddenly under a quick strain.

But how many motorists oil their steering gears or any working parts other than those of the engine? Not many. That is why automobile manufacturers are fairly correct in their estimate that 75 per cent of all repairs and 50 per cent of all depreciation is due to inadequate lubrication.

When you receive your car from the dealer, all parts are well greased and oiled. Ask him then what oil to use in the crankcase at each season of the year. Different makes of cars require different types of oil. He will tell you the particular needs of the car you purchase.

The crankcase is the most important single oiling locality because from it are oiled all the working parts of the engine interior. Always keep it full—your gage will tell you when it is—but avoid flooding. A heavy white or blue smoke from your exhaust means too much oil.

After running about 500 miles, drain all the oil from the crankcase by unscrewing the plug in the bottom, generally near the rear, and letting the oil run out. Before refilling with clean oil, remove the gum and other sediment. Do this by putting about a gallon of kerosene through the filling tube after replacing the drain plug. Then, with the ignition off to prevent starting, press the starter button and allow the turning motor to splash the kerosene about. If you have no starter, use the crank.

Now remove the drain plug again, giving the starter a few turns while the kerosene is running out. Then fill your crankcase with new oil. About every 1000 miles this refilling operation should be repeated. Inspect your crankcase every day.

The misconception that all lubrication centers in the crankcase is the greatest

cause of depreciation. Although the crankcase takes care of all moving parts of the engine interior, about 40 other places on the average car need oil or grease. These should be inspected and lubricated regularly.

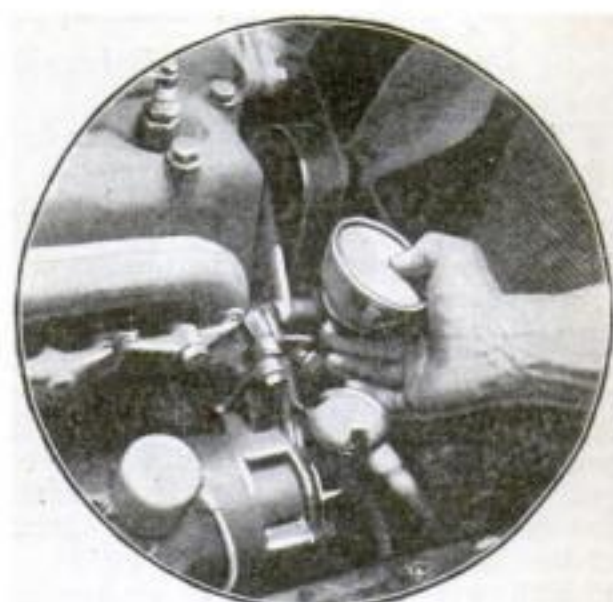
Parts needing attention weekly are the spring shackle bolts, steering gear, fan bearing, and brake mechanism. The shackle bolts are at the ends of the springs and from them is suspended the chassis. At the ends of the bolts you will find a grease cup or grease gun fastening. If cups, fill them and give them two turns every day or so; if grease gun holes, force in heavy grease until the old black grease oozes out through the joints.

You will find an oil hole near the steering wheel which will lubricate the connection with the steering column. Next, grease or oil the reach rod clevis bolts, reach rod ball and sockets and the worm gear. Where there are grease cups, do as you did for the shackle bolts. Where there are oil holes, drop in some light lubricant from a can.

The fan bearing needs a few drops of light oil through the oil hole.

Follow the brake mechanism through the car each week, injecting a reasonable amount of light lubricant at the several joints. The emergency brake should be treated similarly.

Where the front



Where most oilcans never explore—the auto's fan bearing

wheels are connected with the axle, you will find the steering knuckle usually with a small oil cup. Keep this filled with oil, not grease. Lack of lubrication here causes wobbly wheels.

So much for the weekly lubrication.

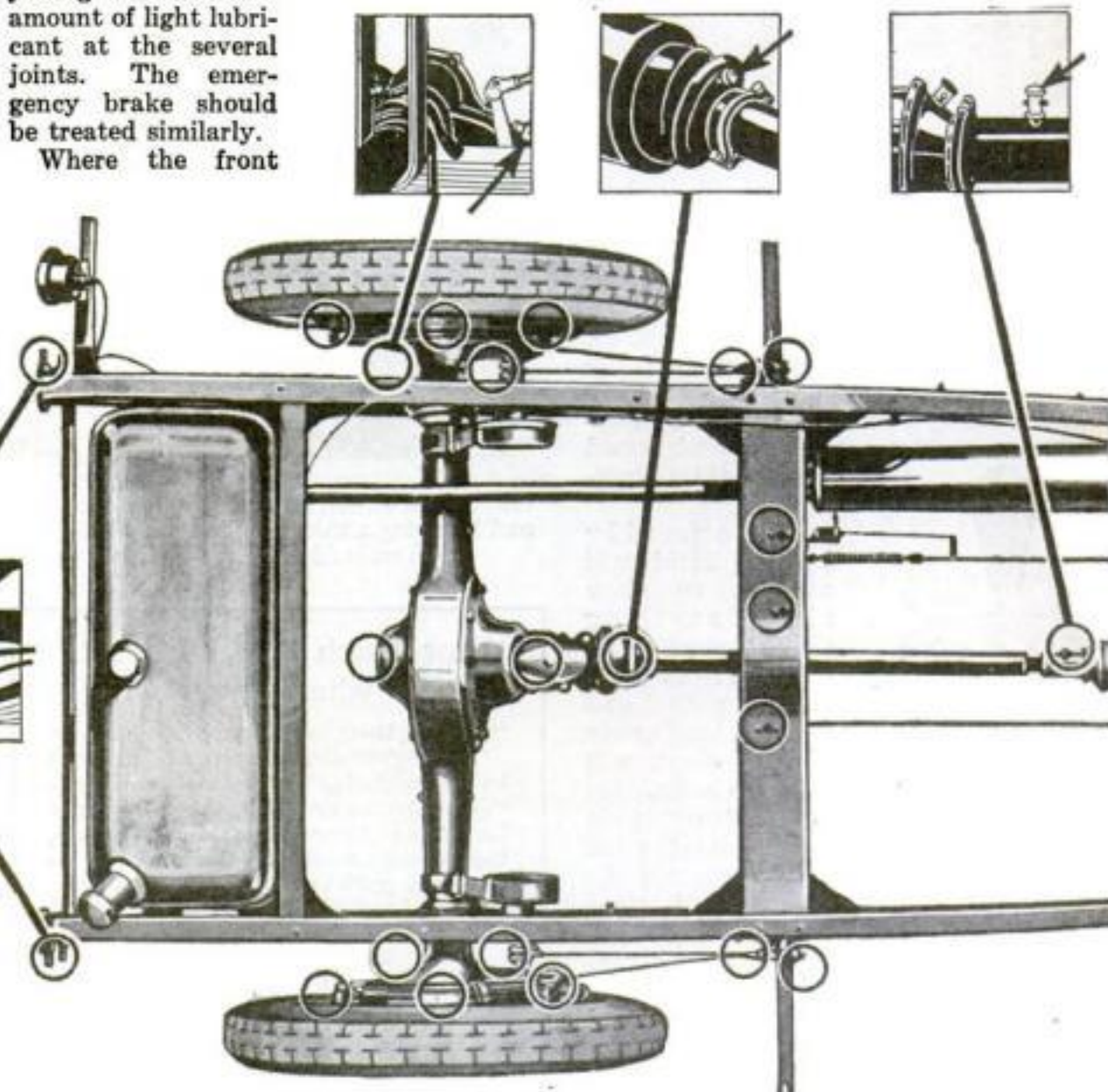
Every month the rear shaft bearing, universal joints, transmission rear support bearing, clutch, generator, distributor, and

Rear axle shaft bearing and emergency brake can. Grease monthly

Rear universal joint. Grease at least once each month

Front universal joint. Grease at least once a week

Spring shackle bolts. Grease at least once each week



Just Where and How to Grease and Oil Your Auto

The above diagram illustrates graphically the precise locations of those vulnerable points where grease and oil can save you

money, inconvenience, and sometimes serious accident. Most of these strategic points are ignored by the average car owner

starting and horn motors should be looked to.

Usually there is a grease cup on the rear axle shaft bearing, just outside the frame near the brake bands. Fill this with the kind of grease used for the spring shackle bolts. When lubricating this part inspect the axle housing to see if oil is running out on the brake bands. If so, have the joint made tighter.

Next come the two universal joints at the end of the long transmission shaft connecting the gearset and differential in the rear. A fibrous grease made for this purpose should be forced into the grease cups here. Behind the gearset is the transmission rear support bearing, which requires oil, not grease, monthly. Here you will find usually a capped oil hole.

The clutch mechanism should be followed through and all working parts and bearings lubricated with a medium oil. The clutch throw-out bearing has a cup needing heavy grease.

Among parts likely to escape attention because of inconspicuous or not easily accessible location are the generator, usually near the fan; the distributor, from which rubber insulated leads go to the spark plugs; and the starting

and horn motors. Use a few drops of oil wherever there are oil holes, taking care not to flood the distributor parts.

Every three months, you should clean out old oil and grease, and lubricate the remaining parts of the car. Put a little heavy grease or graphite on the starter chain. Fill the starter

It is important that the oil and grease in these parts be not too heavy, since the rapidly rotating parts have a tendency to throw the material out against the case. A heavy grease will be thrown against the walls and stick there, leaving a hole in the center in which the operating parts rotate without any lubrication. This will soon cause wear, and new gears will have to be supplied.

A long walk on a hot, dusty country road once impressed on my mind the importance of proper lubrication in the differential. I had gone driving with a friend. When we were about six miles from the nearest town, something broke. The car stopped with a grinding sound. We made an inspection and found a small pinion in the differential had broken, due to lack of lubrication. The grease in the housing was too heavy and had been thrown away from the gears so that they were left hot and dry. My friend and I had a long walk to town.

But in avoiding too heavy grease, take care not to get it too light. The consistency of the lubricant should be such that it will run slowly, but should not be so light that the film will be too thin to supply proper greasing.

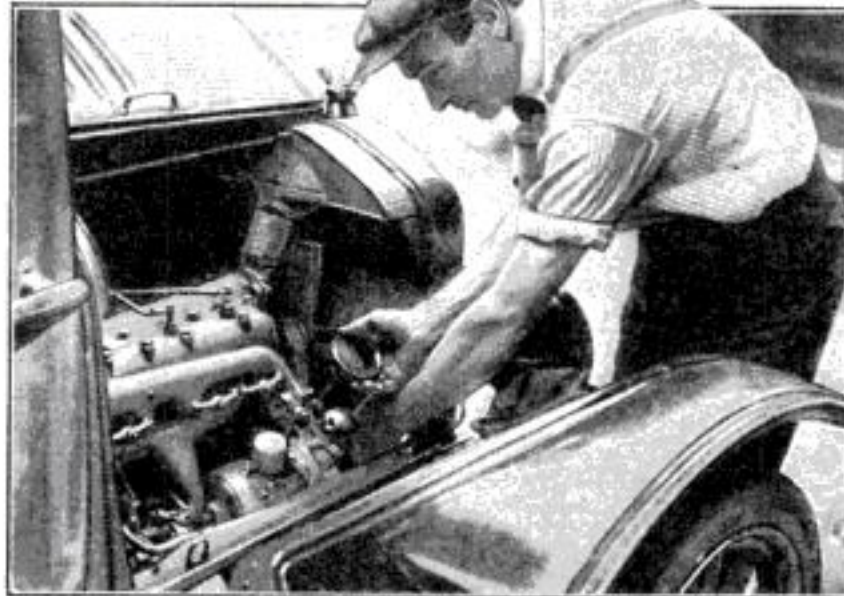
If your car has disk clutches requiring oil, all the old oil should be removed every 1000 miles at most. Do this through the drain in the casing. The clutch should then be washed by pouring kerosene into the casing and allowing it to drain dry. Light clutch oil then should be put into the level of the bottom of the clutch shaft.

If you have a splash-feed system, a scant teaspoonful of motor graphite to each quart of oil in the crankcase should polish the parts well and greatly reduce friction. For a forced-feed system use a small amount of dry graphite weekly, letting it be inhaled through the carburetor's air intake.

Too much oil in the crankcase may be more injurious than too little. This excess usually is indicated by white or blue exhaust smoke. Sometimes the smoke emerges in single puffs, indicating that only one cylinder is flooded. Whenever this occurs, clean the spark plugs.

The purchaser of a car should study the oiling chart shown here and should ascertain the type of oiling system used in the new automobile, for no time is better spent than that consumed in securing proper lubrication. If you want your car to last, you must give it the attention that engineers bestow upon the engines of the power plants that supply your home with electricity and that locomotive drivers devote to the care of their power unit.

Finally, remember always that friction is the worst foe of your automobile and that lubrication is the worst foe of friction.



Don't forget your starting motor and generator

gear case with a heavy grease. The plug in the transmission case, behind the shifting lever, should be removed and the case filled with heavy transmission oil or light grease. Treat similarly the differential housing on the rear axle, filling up the cases to the level of the oil holes.

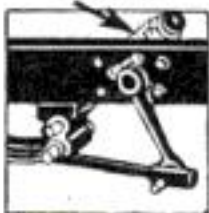
Transmission rear support bearing and universal joint. Oil monthly



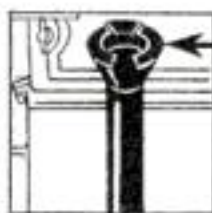
Transmission. Light grease or transmission oil every 90 days



Steering gear, spring and shackle bolts. Grease at least once a week



Crankcase. Keep filled with oil and watch indicator daily



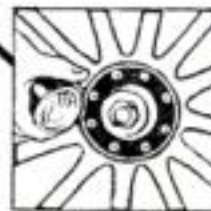
Fan bearing. Grease weekly



Steering knuckle bolt. Oil weekly



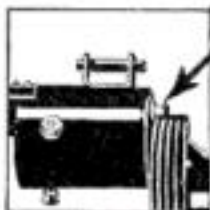
Front wheel bearings. Grease every 90 days



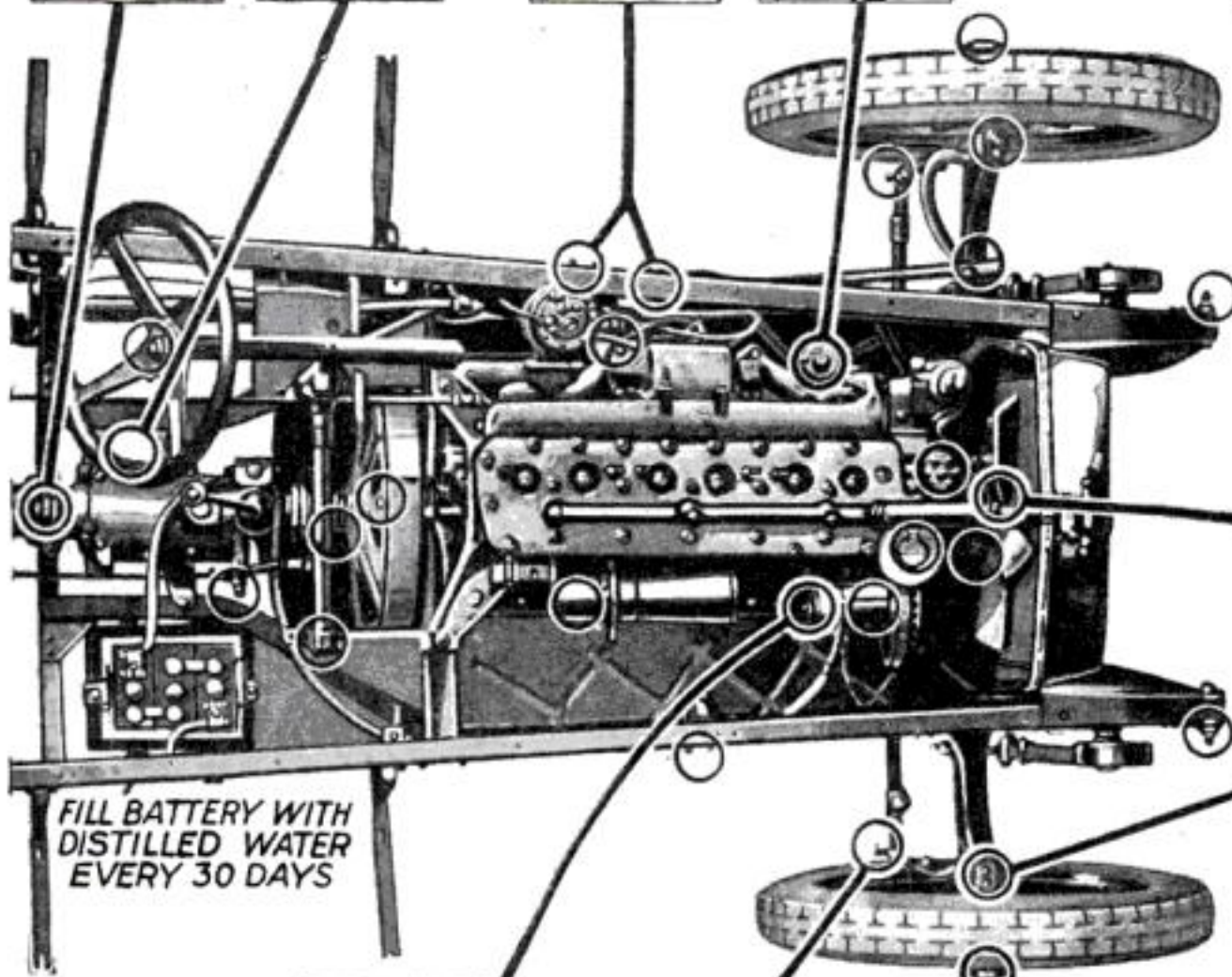
Reach rod clevis bolt. Grease weekly



Starter motor. Oil monthly



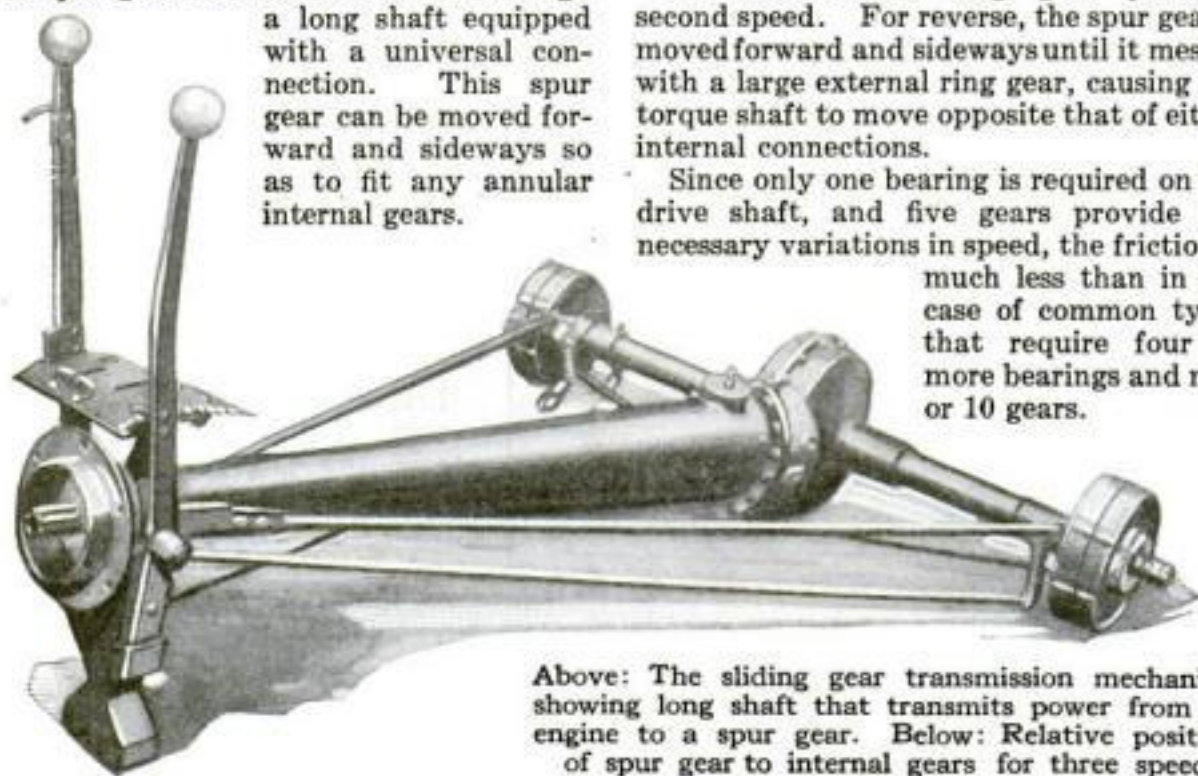
FILL BATTERY WITH DISTILLED WATER EVERY 30 DAYS



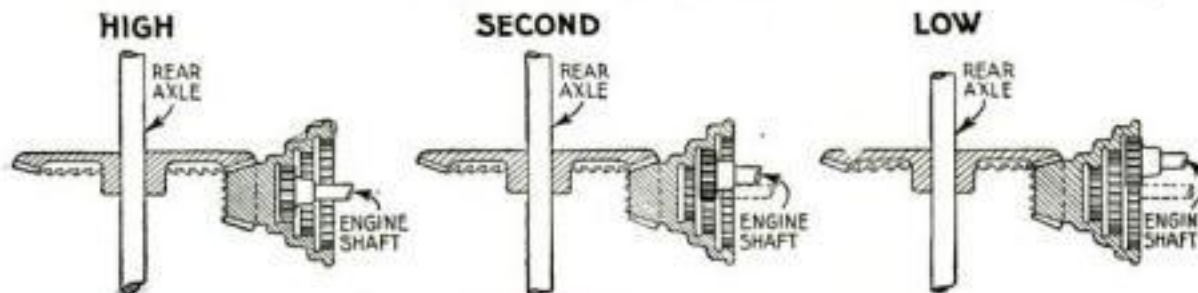
Sliding Gear Simplifies Transmission

A SLIDING gear automobile transmission of a radically new type has the advantage of eliminating most of the gears and bearings that make up the present complicated transmission mechanisms.

Power from the motor is communicated to a spur gear near the differential through a long shaft equipped with a universal connection. This spur gear can be moved forward and sideways so as to fit any annular internal gears.



Above: The sliding gear transmission mechanism, showing long shaft that transmits power from the engine to a spur gear. Below: Relative positions of spur gear to internal gears for three speeds



When the spur gear is meshed with the largest of these, the differential gears turn most slowly, thus giving low gear. When meshed with the smallest gear, the drive shaft is in direct line with the differential shaft, and as a result high speed is obtained.

An intermediate ring gear provides second speed. For reverse, the spur gear is moved forward and sideways until it meshes with a large external ring gear, causing the torque shaft to move opposite that of either internal connections.

Since only one bearing is required on the drive shaft, and five gears provide the necessary variations in speed, the friction is much less than in the case of common types that require four or more bearings and nine or 10 gears.



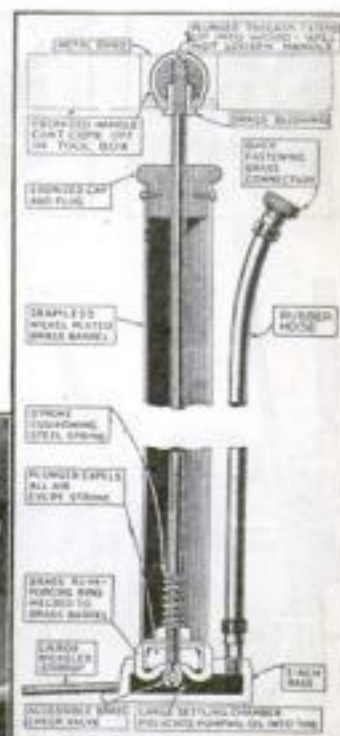
New Sidelights for Autos Prevent Accidents

HOW many times would an automobile headlight providing a generous side ray have spared an accident along country roads at night?

Such a lamp has been invented. It throws a wide flood of illumination to the side of the car. Two of the lamps on an open or closed car can be moved at the will of the driver to throw their rays in any direction. They are controlled by a switch on the dash.

Efficient Tire Hand Pump Prevents Waste Effort

THIS newly devised tire pump, said to deliver more air with fewer strokes than any other hand pump on the market, has been perfected by a Kansas manufacturer.



The unique construction of the plunger and barrel is said to eliminate waste compression, to insure all the air from the barrel going into the tire at each stroke, and to make it impossible to pump oil into the tire.

The absence of a screw cap on top of the barrel eliminates another feature objectionable to automobile drivers.

Know Your Car

The Generator and Its Circuits

YOU may know that the generator on your car supplies electricity for the ignition, starting and lighting systems; but do you know how it is connected with the rest of the circuit?

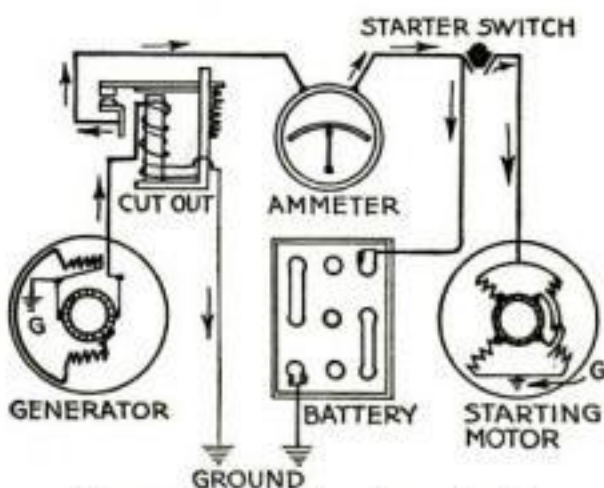
The generator itself is shunt wound, that is, a part of the electricity produced is shunted through the coils that provide the magnetized field through which the wires of the armature cut. The remainder of the electricity passes off on a wire to the cut-out. This cut-out serves to prevent the stored energy of the battery from dissipating itself by running back to the generator while the engine is stationary.

When the generator voltage has reached 6.5, which occurs when the car is traveling eight miles an hour in high gear, the cut-out points are brought together under the action of a temporary magnet. The current then can flow through the cut-out to the ammeter, which indicates that the battery is charging. Upon passing the ammeter, the circuit is broken, one part going to

the battery and the other to the starter switch. The break is made at this point so that the current used to turn the starting motor will not pass through and burn out the ammeter. The starting motor requires from 120 to 250 amperes, and the usual ammeter is designed to carry only 30 amperes. Since the generator can produce only 22 amperes, it is necessary to utilize the stored energy of the battery for starting.

There are several complete circuits in the system. One terminal of the generator is grounded and one wire of the cut-out is grounded. Thus a complete circuit is formed whenever the generator operates, even though the cut-out points are separated. Then, too, the battery is grounded, forming a complete circuit—cut-out, ammeter, battery, and through ground back to generator.

One terminal of the starting motor is grounded to provide the return whenever the starter switch is thrown in.



How generator fits into circuit

More Service and Convenience from Your Car

FOR CLEAR SCIENCE MONTHLY

75



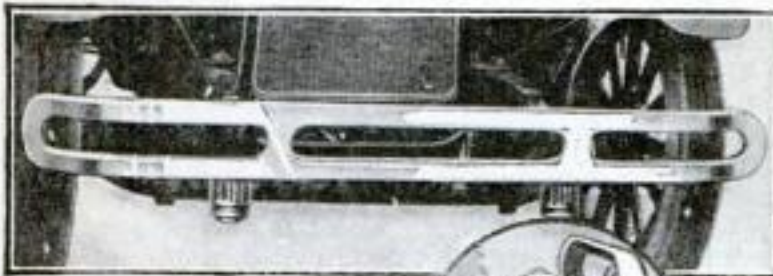
One of these gages on each tire will tell the air pressure at any minute, eliminating the use of a pocket gage and the removal of two tire caps



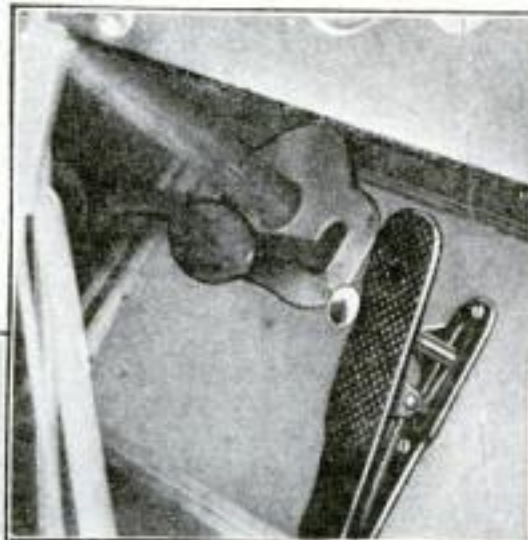
When in danger of striking a pedestrian, the driver of a car, simply by operating a lever, can drop this safety bumper instantly. As the bumper drops, a canvas fender unfolds to catch the pedestrian



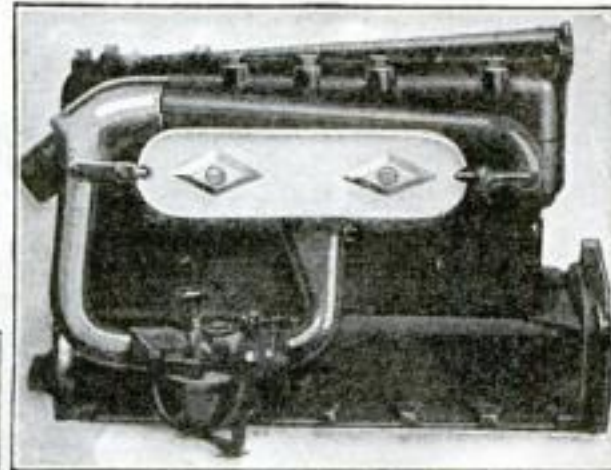
Inserting a locknut in a hole bored and threaded through the lower part of motormeter flange is said to obviate rotting washers, to keep the crossbar in line, and to baffle thieves



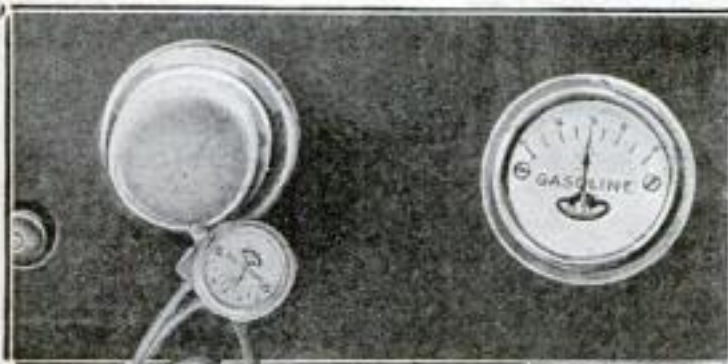
This flexible bumper; designed to absorb the shock of impact with yielding cord springs instead of meeting it with the rigidity of most bumpers, is said to minimize the consequences of slight collisions. Inset, one of the cord springs



The foot accelerator shown above, at left, is said to maintain an even gas flow on rough roads. Above: How the pedal, which cannot be pushed down until the feed button is pressed, frictionally keeps the flow constant. Withdrawing the foot will retard the gasoline flow



A new hot spot for Ford manifolds (at left) absorbs heat from exhaust and directs it against the intake, into which inertia will throw all unvaporized fuel



Above, a gasoline dial gage for the instrument board. The positions of the float in the gas tank are conveyed electrically to the dial by the apparatus shown at the left



This automatic traveling cleaner rod, operated noiselessly by the motor's vacuum, clears the entire length of the windshield and so affords complete driving vision, no matter what the weather



With this jack, pressure on a pedal lifts a light car. The device keeps the hands clean and avoids many injuries

Inverse Duplex Set Will Double Amplification

By Joseph Calcaterra

OF POPULAR SCIENCE MONTHLY'S
Radio Staff

THE Flewelling set described last month represents the highest development of the simpler radio circuits using a single vacuum tube. This month I am describing the construction of a more elaborate receiver, which uses two vacuum tubes and a crystal detector, and in tests has given exceptional results for a two-tube set.

Those who read Jack Binns' story on radio frequency and reflex circuits in the September issue will have little trouble in understanding the theory and operation of the circuit used in this set. It is, indeed, practically identical with the inverse duplex circuit explained in that article, with the exception that no condenser is used across the secondary winding of the tuning unit, a single rheostat controls the filament current of both tubes, and a battery switch has been added so that the A battery may be disconnected when the set is not in use.

This switch is important because it prevents running down the A battery uselessly through the potentiometer connected across the battery terminals.

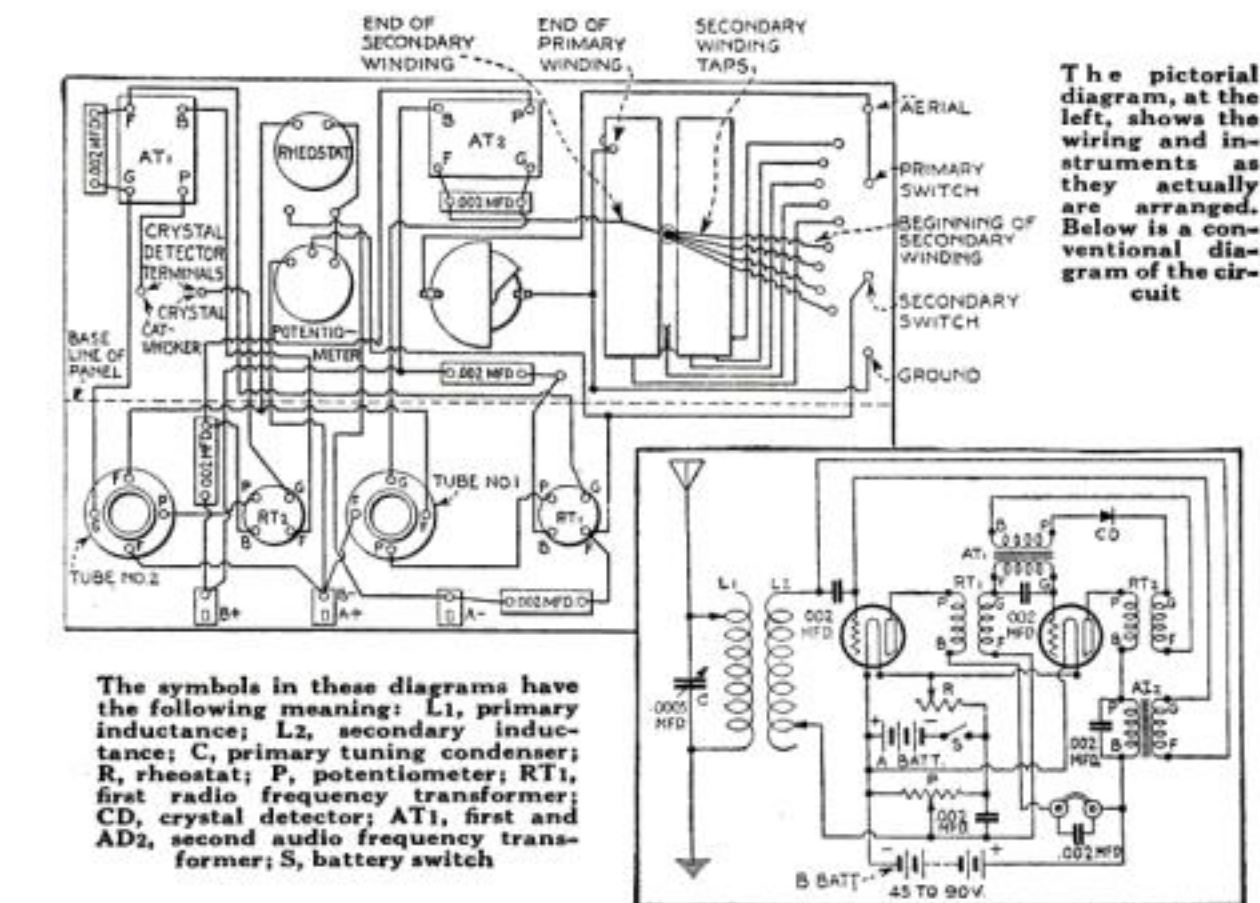
The tuning unit is made by splitting the stator and rotor windings of a standard wooden variometer of the hollow shaft type having about 40 turns on both the stator and the rotor. The stator winding is then used as the primary, while the rotor winding is used as the secondary.

How to Obtain Closer Tuning

To provide closer tuning in both the primary and secondary circuits, the windings are tapped, six taps being taken on the primary winding and five taps on the secondary winding. This is done by disassembling the variometer, lifting the wire where a tap is to be taken, and drilling a small hole from that point to the outside of the stator or the inside of the rotor. The lead can then be inserted from the outside and the end carefully soldered to a bared portion of the winding. The wire is then forced back into place, care being taken that the tap has been made carefully so that it will not make contact with adjacent turns and short circuit them.

The right-hand half of the stator, as shown in the picture diagram, is divided according to the number of turns as nearly as possible into three equal sections, while the left-hand end is divided into two sections. The joint where the halves of the winding are soldered together is taken as another tap, so that, counting the outside ends, there will be six taps in all. The leads from these taps are connected as shown in the picture diagram, five of them going to the primary switch, while the sixth connects with the ground post.

The secondary winding is tapped so that four of the leads go through the hollow shaft to the secondary switch points, while the fifth is connected with the F terminal of audio transformer No. 2. The leads should be left long enough so that there is



no tendency for the wires to act as springs and prevent the smooth operation of the rotor.

Provision should be made for a stop on the rotor shaft to prevent the rotor from being turned through more than one revolution. If this is not done, the leads from the secondary will soon be twisted and weakened, the insulation damaged, and the circuit rendered inoperative by short circuits. The wire used for the leads should be of the flexible variety, obtainable at practically any electrical supply store.

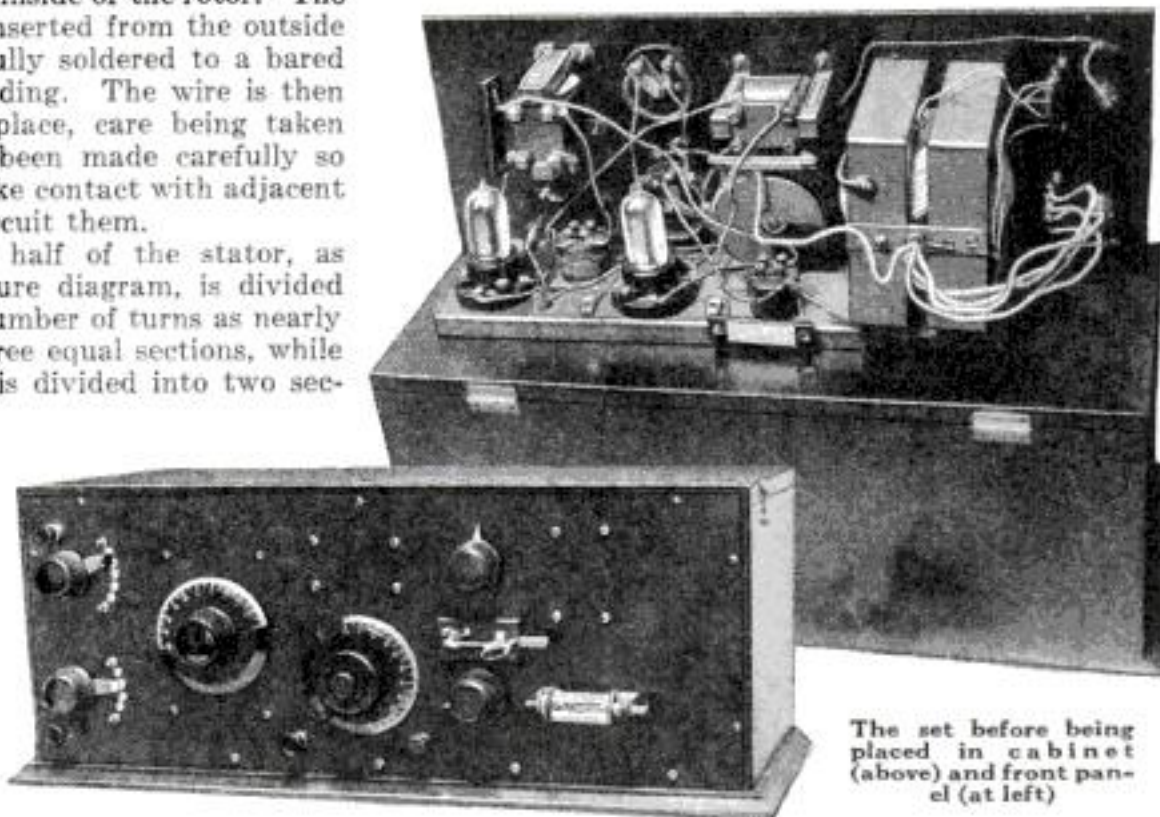
If the constructor does not care to use the tapped variometer type of tuning unit, he may use instead any standard or home-made type of variocoupler. In that case,

It is, of course, impossible to give exact dimensions regarding the placing of the parts on the panel and in the cabinet, as these dimensions depend considerably on the type and size of the parts used in making the set. In making the set illustrated, however, a 7 by 18 in. panel was used, so that if you use a panel of this size, with a cabinet of corresponding proportions, you will have no difficulty in placing your instruments in the same general positions as those shown in the photograph. In this set the three 1½-volt batteries for the filament current and four small B batteries go inside the cabinet. This makes a compact, self-contained receiver.

The operation is very simple. After closing the battery switch, the rheostat is adjusted so that the tubes are burning fairly brightly. By varying the adjustment of the tuning elements of the set and testing various spots on the crystal with the catwhisker, a spot will soon be found that is sensitive and brings in one of the broadcasting stations that happens to be "on the air" at the time. Once this adjustment is obtained, no further attention to the crystal is necessary and it can be left at that adjustment until such time as it should be jarred accidentally from its position.

Once the sensitive spot has been located, any desired station can be brought in by the usual manipulation of the tuning elements and by a proper adjustment of the potentiometer. Then the rheostat can be reset so that the current flowing through the filament is as low as possibly consistent with good results.

If clear reception is not obtained after you have made all possible adjustments, you may try grounding the catwhisker side of the crystal detector circuit. This expedient will often bring in the station, but it should not be tried unless the set does not respond to the other adjustments.



The set before being placed in cabinet (above) and front panel (at left)

the primary coil of the coupler can be tapped in the usual way by the use of a tens and a units switch and the variable condenser can be used across the secondary of the coupler instead of across the primary coil. Where this is done, however, it is desirable to use a Vernier condenser of three plates, if possible, across the primary winding in order to get close tuning.



The Home Workshop

Arthur Wakeling, Editor

How to Rebuild a Broken-Down Car

NO MATTER how little money he has to spend, the man who is mechanically minded and has a genuine enthusiasm for automobiles never need be without a smoothly running and good looking car.

What can be done in remodeling a broken down car is strikingly illustrated at the right. The car shown is a 1918 model of a roadster six, built by a good manufacturer. Although subjected to hard use and some abuse, it was still in fair running condition when it went into the ditch and was reduced to the unsightly wreck of the lower illustration. It was bought for \$75, which was high, if anything, and remodeled at a cost for materials of \$135.15. This included paint, top, and tires.

This was not a freak performance; any wide-awake mechanic interested in automobiles can do as well. In fact, it is often possible to buy a car for less and put it in running condition at a smaller expenditure. It is even easier, however, to pay as much or more for a used car and never be able to make anything out of the machine.

Half the battle in remodeling a used car is, indeed, to pick out one that can be put into good shape easily at low cost. To make a wise purchase is of primary importance, and nothing but disappointment awaits the mechanic if he does not choose a car strictly on the basis of the repairs necessary to reconstruct it.

Year after year hundreds of thousands of used motor cars are placed upon the market, but only a certain proportion of them are worth buying for remodeling. Special precautions and unusual methods must be taken in selecting a car.

First of all, look at a number of cars before deciding to buy. What you must look for is a solid frame, an engine having no scored cylinders, a starter that works, generator that shows signs of being healthy, bearings that are not too noisy; in other words, a good power plant.

Start your search by inquiring among friends whether they know of a used car for sale. Then, too, it would be well to make the round of the secondhand dealers. While their cars usually are fixed up to

By Ray F. Kuns

Principal, Automotive Trade School,
Cincinnati, Ohio

THIS is the first of a series of three articles on how to remodel a used car. Next month Mr. Kuns will tell how to overhaul the rear end, the transmission, and clutch.



The used car before and after remodeling. It was literally picked out of a ditch



strike the eye and may have engines of doubtful quality, one can sometimes obtain a good one. At any rate, you will get an idea of the average prices.

The question of size plays an important part in the price of secondhand cars. There is a greater market for the smaller ones and hence the price is proportionately less for the larger models. Furthermore, one should purchase a make of car for which repair parts can readily be obtained. Obsolete makes are very cheap, but don't be tricked into buying one you cannot repair because of the difficulty of obtaining replacements.

Looking Over the Mechanism

Having found a car that comes within the price range and will answer your needs as far as size is concerned, take up the all-important consideration of the mechanism and the possibilities of repairing it.

First, are the cylinders and piston rings in good condition? Leaving off the ignition, turn over the engine very slowly with the hand crank. Note whether or not the compression reaction in all cylinders seems to be about the same. In a four-cylinder engine, if three are strong and the fourth is weak, try to learn which one is defective. If there is a hissing noise as the com-

pression escapes, it may mean a scored cylinder or bad piston rings. In that case, ask permission to remove the head and inspect the cylinders. If a cylinder is scored, leave the car alone; but if only the piston rings are worn, these can readily be replaced.

Another way would be to have the owner run the engine for you. If there is a hissing sound emerging from the breather tube, take a look at the cylinders, for it would indicate that the compression was leaking into the crankcase.

How about the generator? If, while the engine is running, the ammeter on the dash indicates that the battery is charging, you do not have to worry about the generator.

Take a look at the pump shaft and other exposed drive parts to see how they run. There may be some play there that will impair the efficiency of the engine. Listen to the valve lifters and, if overhead valves, to the rocker arms. Is there play that causes rattling?

If the self-starter is operated from the flywheel, remove the inspection plate and take a look at the teeth. Very often these become ground down through long operation and poor lubrication and eventually such worn teeth will break and leave you without a starter.

How about the radiator? See if it holds water and whether or not the pump throws water into the top tank when the engine is speeded up. If it does not flow down through the radiator core properly, it will fill the upper tank and overflow, indicating that the core is stopped and may have to be renewed.

And how are you going to determine the amount of play in the transmission system? Just jack up one of the rear wheels, throw the gearshift into high with the engine stationary and turn the jacked-up wheel as far as it will go. If the wheel does not rock more than 4 or 5 in., the parts probably are good. If the wheel rocks a quarter turn, inspect the universals and propeller shaft and see if you can locate the play there.

There should not be too much play in the
(Turn to page 114)



The chassis stripped and ready for a thorough cleaning



The frame stripped, cleaned, and ready for inspection

Making the Most of Your Home Workshop

WHEN polishing with an emery cloth, the holder shown in Fig. 1 is more satisfactory than a flat file.

The cloth is cut the right width and the ends are folded and slipped into the diagonal slots. The abrasive is then tightened by screwing the windnut.—G. A. L.

IN THE middle of a job, when the need for a surface gage came up unexpectedly and no gage was available, the serviceable substitute illustrated in Fig. 2 was quickly put together. The parts used are a 1½-in. brass pulley with a ¼-in. hole, a length of ¼-in. steel rod, an old brass screw with a large hexagonal head, a piece of ½-in. tool steel, and two thumbscrews with milled heads.

One end of the ¼-in. rod was pressed into the pulley and the other was drilled, so that the threaded part of the brass screw could be passed through. The milled nut holds the screw in any position in which it is turned. Through the head of the large screw was drilled, from side to side, a hole to take the ⅛-in. rod used as the scribe. Another hole was drilled to meet it and tapped for a 6/32 machine screw to clamp the scribe in place, bending one point before tempering.—H. G.

FOR workbench drawers and other drawers that are better for having flush handles, and where appearances are not important, leather serves very well for the handles. Simply cut a cavity about 3 in. in diameter with an expansion bit and tack a semicircle of leather over the upper half of the hole (Fig. 3). If the edges of the leather are inlaid in the wood, the job will be all the neater.—THOMAS W. BENSON, Philadelphia, Pa.

IN A home workshop where the tool equipment is limited, the bit brace may be used for simple turning, coil and spring winding, and other work that requires slow, heavy, positive rotation.

The brace is mounted in wooden supports, high enough to permit the handle to be turned freely, as shown in Fig. 4. A simple tool rest can then be made, and, if desired, a clamp for holding and feeding a tool against the work.

Two cones arranged to slide on a rod that can be gripped in the bit chuck, will serve to hold various sizes of cylindrical forms for radio coils. With other fixtures that can be devised as required, the bit brace will act as a turning machine for the occasional job

that otherwise cannot easily be done with hand tools.—L. A. G.

TOOL handles that are cracked or fractured can often be repaired so as to give good service, especially if the damage is checked in time. A split file or chisel handle can be reinforced by a twisted ferule of soft wire. One end of the wire is laid in a groove cut in the wood and, when the winding is completed, twisted with the

slid back and forth along the wire while the grinder is being turned.—M. C. METZER, Silver Creek, Neb.

A HOLDER made of soft wire, as shown in Fig. 7, is a time-saver in starting small screws in tapped holes that are difficult to reach.

The head of the screw is placed between the two loops and gripped by drawing back the sliding cross piece.—A. C. L.

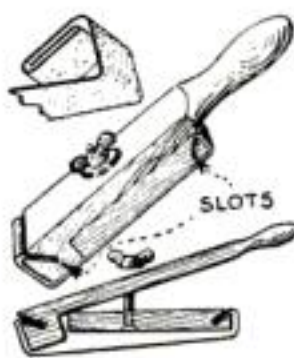


Fig. 1. Emery cloth holder



Fig. 2. Surface gage

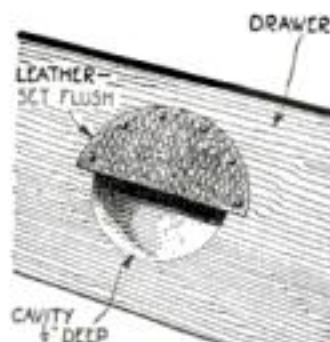


Fig. 3. Drawer handle

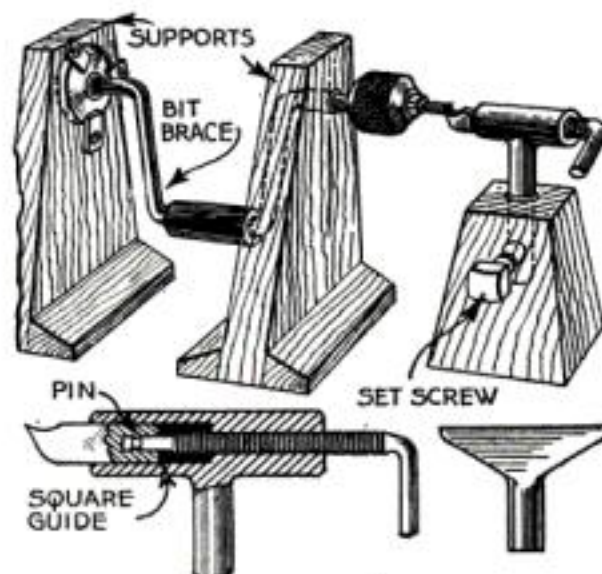


Fig. 4. Bit brace for turning

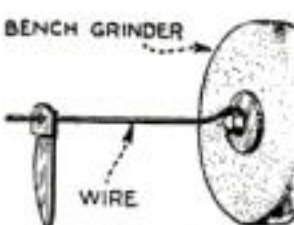


Fig. 6. Enlarging small holes



Fig. 7. Screw holder

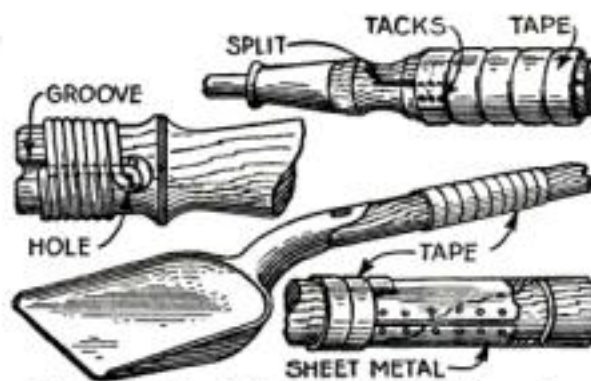


Fig. 5. Methods for repairing tool handles

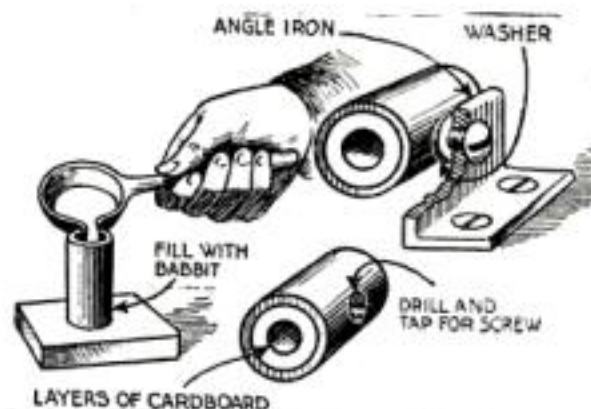


Fig. 8. Small universal bearings

other end, as shown in Fig. 5. The loose wire is then cut off, and the butt forced down into a drilled hole and filed off smooth.

Every one tapes a screwdriver handle, but the tape persistently comes loose unless the end of the last turn is folded and fastened with very small tacks.

A shovel or even a pick handle that is split may often be repaired. File down the wood for a distance of 3 in. on each side of the split to a diameter of ⅛ in. less than that of the handle and tack a sheet of brass or other metal tightly over the cracked part. Wind tape on top, extending it beyond the ends, to make as smooth a reinforcement as possible.—JOE V. ROMIG.

AN ORDINARY hand grinder can be used in the home workshop for enlarging a small hole in tempered steel (Fig. 6). A length of iron wire of a diameter that will just slip through the hole, is bent into a ring at one end. This eye then is turned at right angles so that it can be fastened to the grinder spindle by means of the wheel locknut. Valve grinding compound is applied to the wire, and the piece to be reamed is

for working brass, but with all the angles somewhat less acute, and see that they are as hard as fire and water will make them. The speed of the work should be quite slow as compared with that used for turning brass. Particular pains should be taken to keep the point of the tool always cutting; do not allow it to scrape along the surface without taking a bite, for it will then act as a grinder and rapidly wear off the edge. Do not take too heavy a cut, although that is better than to scrape without cutting. No matter how hard the tool may be, it will require frequent sharpening.—H. C.

FOR filing a finish on a small flat surface, one of the best ways is to lay the file flat on the bench and move the job over it instead of attempting to keep the file in one place while moving it across the work held in a vise.

With but little care a very true surface can be produced. An excellent type of file for this is what is known as an "equaling" or "parallel" file, which has no taper. A smooth-cut file is much better for small work than the coarser cut files.—L. P.

SMALL machine bearings that can be mounted on surfaces of almost any shape and that are adapted to all sorts of positions, can be made quickly from ordinary gas- or water-pipe. Obtain pipe about ½ in. larger than the shafting for which the bearing is to be used, and saw off pieces 1 in. long or longer. Fill each with babbitt, place it in a lathe, face it off and drill for the shaft. Next, drill and tap a 3/16- or ¼-in. hole, as shown in Fig. 8, and mount the bearing on a short length of angle iron. Many combinations of bearings and angle irons are possible, and the construction is strong enough for light work.—C. F. KLINGER, Pittsburgh, Pa.

HARD fiber is exasperating stuff to work on the lathe, chiefly because it so quickly spoils the cutting edge of a tool. Grind the cutting tools as

The Proper Finish Will Make Your Furniture Harmonize



Small odd pieces of modern furniture add greatly to the attractiveness of every home. You, yourself, can easily make them for your family. There is no particular trick to constructing porch swings, tables, telephone sets, etc.

The furniture, woodwork and floors of your home can be made to harmonize if a little taste is used in finishing them. You can easily refinish dingy, shabby, scratched wood. Our method involves practically no expense. All you need is a little time—a brush—and **JOHNSON'S WOOD DYE.**

Johnson's Wood Dye is very easy to apply—it goes on easily and quickly, without a lap or a streak. It penetrates deeply, bringing out the beauty of the grain without raising it—dries in four hours and does not rub off or smudge.



JOHNSON'S WOOD DYE

JOHNSON'S WOOD DYE has many uses, for both the artisan and amateur. *Architects and contractors specify it for coloring woodwork and flooring in new buildings. Painters and decorators use it with equal satisfaction on new and old woodwork of all kinds.*

Housewives delight in it for doing over old furniture and for coloring reed and wicker baskets, etc.

JOHNSON'S WOOD DYE is made in fourteen standard shades—a few of which are:

129 Dark Mahogany	126 Light Oak
127 Brown Mahogany	123 Dark Oak
140 Early English	110 Bog Oak
131 Walnut	124 Golden Oak
125 Mission Oak	

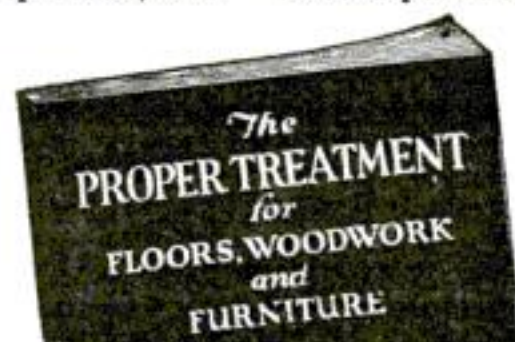
All shades may be easily lightened, darkened or intermixed.

Full directions on every label.

If you are building or remodeling you should have our authoritative book on Wood Finishing. It is chock full of valuable and interesting information. We will gladly send it free and postpaid for the name of your dealer. Use coupon at right.

FREE-This Book on Home Beautifying

This Book tells how to finish wood in artistic stained and enameled effects. Gives practical suggestions on making your home artistic, cheery and inviting. Tells just what materials to use and how to apply them. Includes color card—gives covering capacities, etc. Use coupon below.



S. C. JOHNSON & SON, PS10
RACINE, WIS. (Canadian Factory—Brantford)

Please send me free and postpaid your Instruction Book on Home Beautifying and Wood Finishing.

The best dealer in paints here is

MY NAME.....

MY ADDRESS.....

CITY & STATE.....



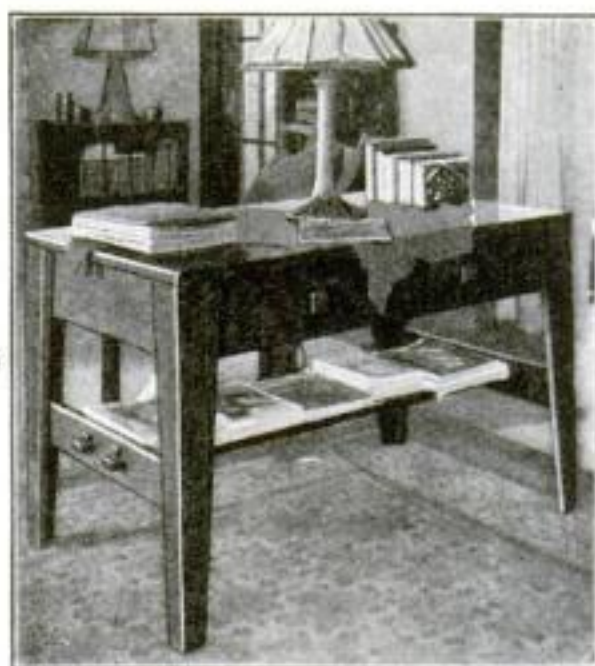
How to Build Serviceable Tables Quickly

By Leslie W. Lyon

AMATEUR woodworkers who have had little experience or cannot spend much time in their home workshops, often do not care to attempt making mortise and tenon joints, or even plain doweled joints. These workers will find useful the type of table construction shown in the accompanying illustrations.

This method of joining table frames was first suggested to me by an old mechanic and since then I have used it for making all sorts of tables—library tables, large dining tables for porch use, writing tables for the summer camp, and, finally, a play-room table for the nursery.

The advantages of the construction are that the entire table is made from $\frac{5}{8}$, $\frac{3}{4}$, or $\frac{7}{8}$ -in. stock, that only the simplest screw joints are used, that the table can be knocked flat in five minutes for shipment or storage, that an ordinary carpenter can build one from plain lumber within two



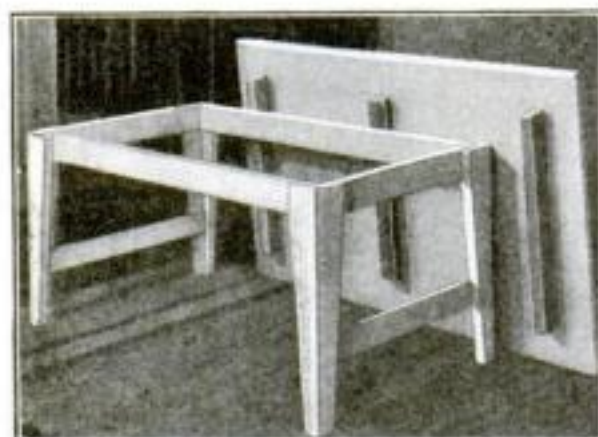
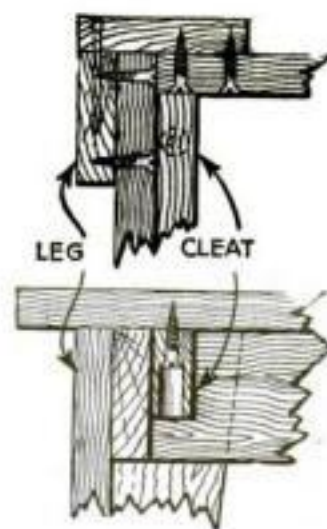
A library table with a lower shelf made of $\frac{7}{8}$ -in. stock throughout

one or more nails at each end driven at a slight angle toward the center. The rails are then attached to the legs with screws driven in from the inside.

If the table is a large one, it is advisable to connect the lower rails with a shelf. This shelf may simply be screwed to the top edges of the lower rails or to cleats that have previously been screwed to the inside

of the rails. A neater method is to mortise and tenon the shelf into the end rail, as shown in the center illustration above.

The boards forming the top are held together with three cleats. I have never fastened the tops directly to any of the tables, but merely have placed the end cleats edgewise in such



The general table construction is shown above and the joint details at the right

hours, and that the finished table is neat, strong, and durable.

Each leg is made of two pieces nailed together with finishing nails. Holes should be drilled for the nails, especially if hard wood is used, and, if a thoroughly durable job is desired, the joints should be coated with thin glue before nailing. A nail is first put in the center of the leg and then

a position that they fit just inside the top end rails of the table. In fastening the cleats to the top, I use large round-head screws, first boring holes edgewise into the cleats to let the heads of the screws in about an inch and then boring holes for the screws the rest of the way of such a size that each screw will have a little play. This allows for any expansion or contraction of the boards. A single screw run through the cleat and into the end rail at each corner will hold the top in place, if thought necessary. It is, of course, imperative to use screws and not nails for all the joints except those connecting the long, tapered boards used as leg members.

Any type of finish may be used. The library table illustrated is oak, stained, shellacked, and waxed. The play table is birch, carefully sanded and finished with two coats of flat white paint and ivory enamel, the last coat being rubbed with finely powdered pumice stone and water.

The porch dining table, not shown, was



A play table made of birch and finished in ivory enamel rubbed smooth with pumice stone

painted white on top with bright green legs and frame. This table and several ordinary kitchen chairs painted in the same color combination, make an attractive summery looking luncheon set. The table itself, although about 6 ft. long, is taken apart at the end of the summer, and stored very compactly in the attic.

Magnet Changes Telephone into Sensitive Loudspeaker

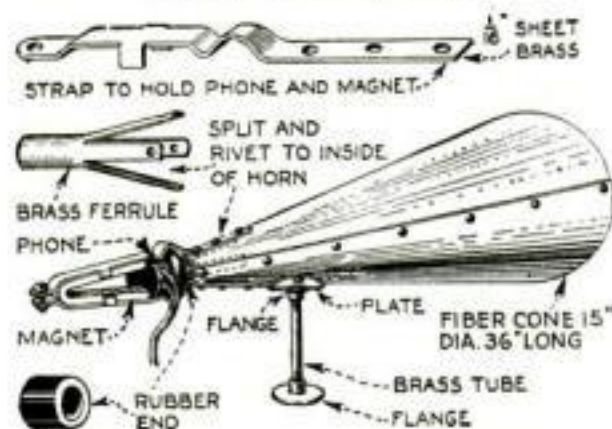
BY ADDING a powerful permanent magnet to an ordinary homemade loudspeaker, it can be made sufficiently sensitive to operate even with a crystal set, provided the receiver is quite close to a broadcasting station. The same loudspeaker, with a vacuum tube set or a combination crystal and vacuum tube receiver, gives exceptional results.

Most radio experts will be inclined to challenge the possibility of a crystal set's operating a loudspeaker. If you are interested, however, it will cost you little to make the experiment for yourself.

Music from the Arlington station at Radio, Va., five miles away, came in so well through a crystal set and the loudspeaker illustrated, that it could be heard from any position in a room about 9 ft. square. It was low but audible. Two local Washington, D. C., broadcasting stations, both nearer than the Arlington station, also were heard. A good quality commercial telephone with a metal diaphragm was used in the loudspeaker, and the set was of an ordinary variocoupler type.

The loudspeaker was also tested with a Baldwin mica diaphragm telephone, and the magnet added considerably to the

By George A. Luers
Mechanical Engineer



This unique loudspeaker is merely a permanent magnet, an ordinary radio telephone, and a fiber horn combined

strength of signals in both cases. In conjunction with the single tube set, using the same simple variocoupler, the music was clearly and distinctly audible in adjacent rooms, and provided music loud enough for dancing.

The horn of the loudspeaker is made of hard red fiber board. For satisfactory results, the material must be quite stiff.

It is about $\frac{1}{16}$ in. thick, 3 ft. long and 15 in. in diameter at the large end. The joint is fastened with paper fasteners or clinch rivets, preferably the latter. These also are used to fasten the horn to the bracket.

The bracket is a short length of brass tube with flanges at both ends. One flange is fastened to the baseboard or the table, and the other is attached to a thin brass or aluminum plate, which is bent to form a cradle for the horn and riveted to it. The fixture should be free to turn in any direction around its vertical axis.

At the small end of the horn is a brass ferrule or piece of tubing, split, drilled, and attached with rivets. Two brass clamps, bent as shown, are also fastened to the horn to hold the receiver in place. A piece of rubber tubing is drawn over the end of the ferrule so as to bear tightly against the telephone when it is in position.

At the rear of the telephone is located the magnet, which is gripped by the brass straps and placed so that the poles are against the back of the phone. The magnet can be one from an old magneto, or of the kind obtainable at any automobile supply store for use on auto flywheels.

Just Out!

The New RADIO BATTERY EVEREADY "THREE"

THREE CELLS ~ THREE TERMINALS ~ THREE PURPOSES

May be used—

As an "A" Battery for portable sets having UV-199 Tubes.

As a "B" Battery for obtaining additional "B" Battery voltage.

As a "C" Battery for furnishing negative potential to amplifying Tube Grids.



Eveready "Three" has three Fahnestock Spring Clip Connectors making it possible to secure 1½, 3 or 4½ volts from the battery.

Ask your dealer or write us for circular No. 1025 giving complete information on this NEW Three Purpose RADIO BATTERY. Order Eveready "Three" by catalog number 771.

Made by the largest dry battery manufacturers in the world—makers of the famous

Eveready Storage "A" Batteries for Storage Battery Tubes;
Eveready Dry Cell Radio "A" Batteries for Dry Cell Tubes;
Eveready "B" Batteries for all Vacuum Tubes.

NATIONAL CARBON COMPANY, Inc.
Long Island City, N. Y.

Atlanta

Chicago

Cleveland

Kansas City

San Francisco

See our exhibit at Radio Show, Grand Central Palace, New York City, October 6-13

RELIABLE

EVEREADY

Radio Batteries

—they last longer

NOISELESS

Better Shop Methods

How Expert Mechanics Save Time and Labor



Improved Toolpost Speeds Up Lathe Work

By H. L. Wheeler
Machine Shop Foreman

THOROUGHLY tested for a long period by the writer, the lathe toolpost illustrated has demonstrated unmistakably that it has several advantages over the conventional type of toolpost found on the majority of lathes. It has stood up under heavy cuts very much better than the single screw type of toolpost. Even more important, the tool may be swung quickly to any angle and lifted or lowered at will with the precision of a micrometer and without altering the tool setting.

The tool has a better support than ordinarily and is held more rigidly because three binding screws are used. It also may be removed for grinding and replaced in practically the same position. None of the usual puttering around with hammer or wrench is necessary to set the tool back in position. There are no loose pieces when for any reason the toolpost is removed from the lathe; there is nothing to be lost or mislaid. Furthermore, the toolpost may be used for turning and boring either right- or left-hand with equal convenience.

In almost every machine shop one well known type of commercial boring bar is well liked, but these bars often cannot be used because the lathe toolposts either have too much or not enough side clearance for the space between the bar and holder. With this improved toolpost, however, there is no difficulty in using this type of bar and any size bar may be used.

An additional advantage is that the toolpost may be used

as a milling fixture for small jobs, and this feature should find great favor in small shops and garages.

The body (1) is made of iron, although steel may be used, if desired. It should be cast in rectangular form and planed to the

outside dimensions. The slope at the back should not be planed until the hole for the clamping bolt (5) and spacer (4) has been drilled, as it would be a rather difficult operation to machine this hole after the angle has been planed.

The tool slide (2) is made of mild machine steel and should be casehardened. This design shows tapped holes for three binding screws, although I believe two binding screws would be quite sufficient. The dovetail should be planed carefully and fitted to its corresponding seat in the body.

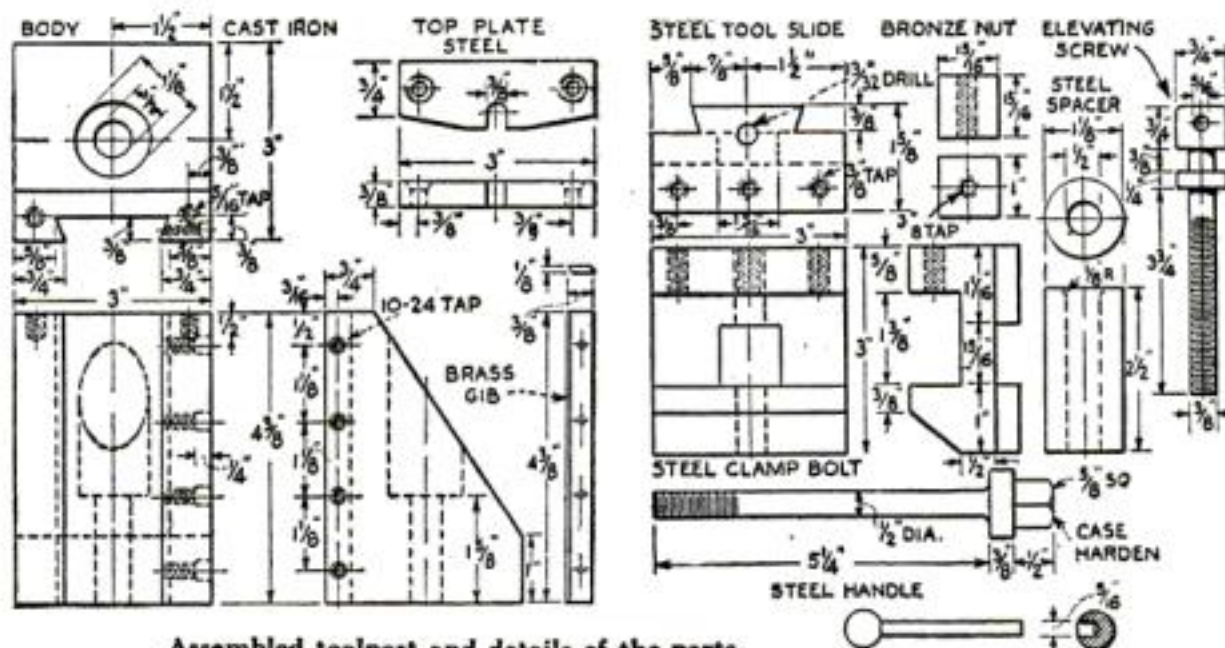
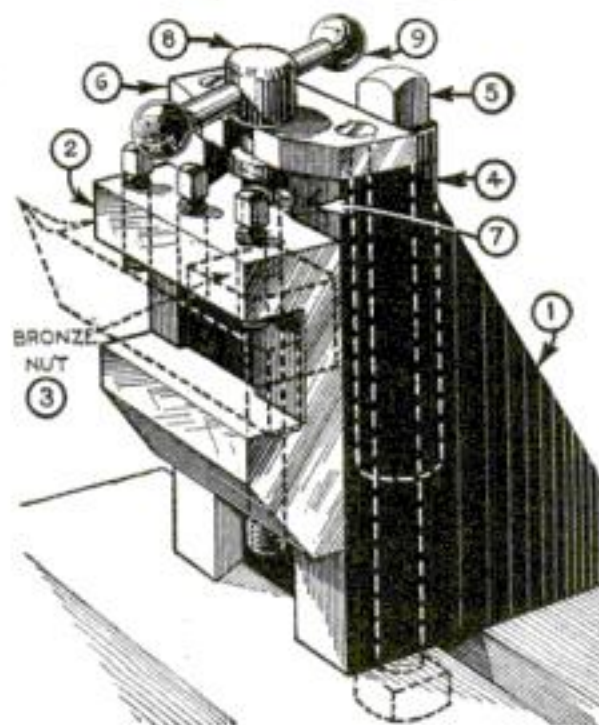
The nut (3) is made of bronze or brass and is merely a cube shaped piece nicely fitted in the square hole in the tool slide. The hole for the elevating screw (8) is located in the assembly after fitting by using a body size drill to spot the hole and then using the proper size tap drill. The hole drilled through the tool slide should be at least 1-32 in. larger than the screw, so that there will be no chance of the screws binding.

The design and dimensions of the top-plate (6), the gib (7), and the handle (9) are made clear in the details. It should be noted, however, that in making the binding

screw or clamp bolt a 5-32-in. fillet is used at the shoulder. I always put a fillet in places like that when possible because it gives additional strength where needed. The clamp bolt and the steel spacer should be casehardened.

The dimensions are, of course, suited only to one size lathe and necessarily will have to be changed to suit the lathe on which the tool holder is used.

The binding screws and all threads are standard.



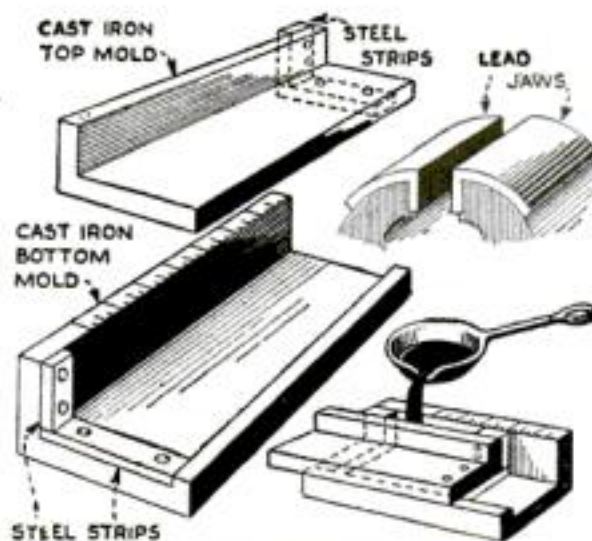
Assembled toolpost and details of the parts

Adjustable Mold Aids in Casting Vise Jaws

IN LARGE machine shops it is frequently necessary to cast lead vise jaws to fit vises of a number of different makes and sizes.

This work is greatly simplified by using the adjustable mold illustrated.

A convenient size for the bottom mold is 4 3/4 by 8 in. over all and for the top mold 3 3/4 by 8 in., the cast iron being 5/8 in. thick. A soft steel strip, 1/4 by 1 by 3 1/2 in., is fitted into the recess of the bottom mold, and a similar strip, 3/8 by 1 by 1 1/2 in., is riveted to the back. Corresponding strips are attached to the opposite end of the upper mold, and the edges are tapered 2 degrees where necessary for clearance. Smoke the mold before using, and make the jaws of lead, not babbitt. Note the scale on back of bottom mold.—H. S. L.

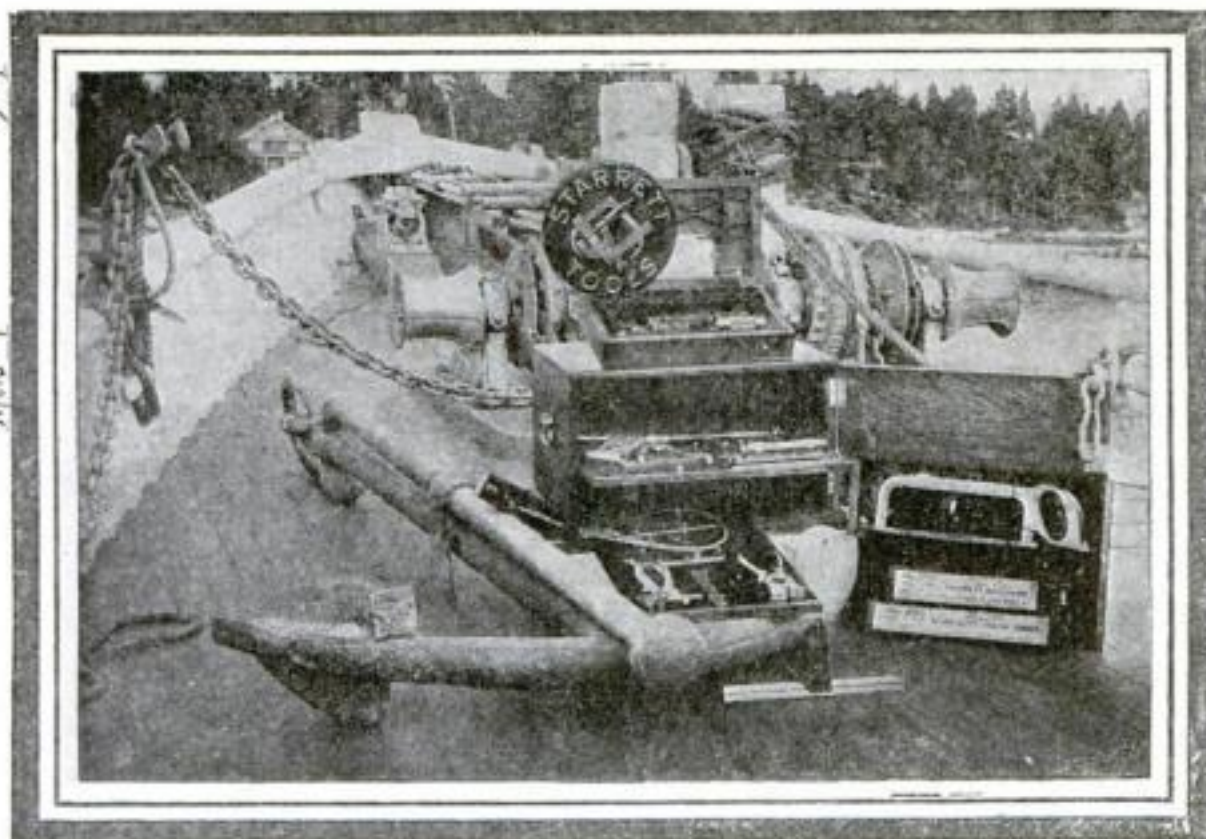


How the mold is made and used

"Close-Up" Knurling Tool

THE offset construction of this knurling tool allows the knurl to work right up against the shoulder. This is an advantage when the work is such that the yoke-like arms of the common type of knurl holder are in the way. The steel shank is machined as shown and fitted with a retaining finger. The knurl pin is hardened tool steel and a driving fit in the tool shank. Case-hardening the shank will prevent wear.—J.R.





MacMillan's choice

Donald MacMillan chooses his equipment for a Polar Expedition as carefully as he chooses his personnel. Tools and men—they *must* be reliable for there is no test of character as severe as the arctic.

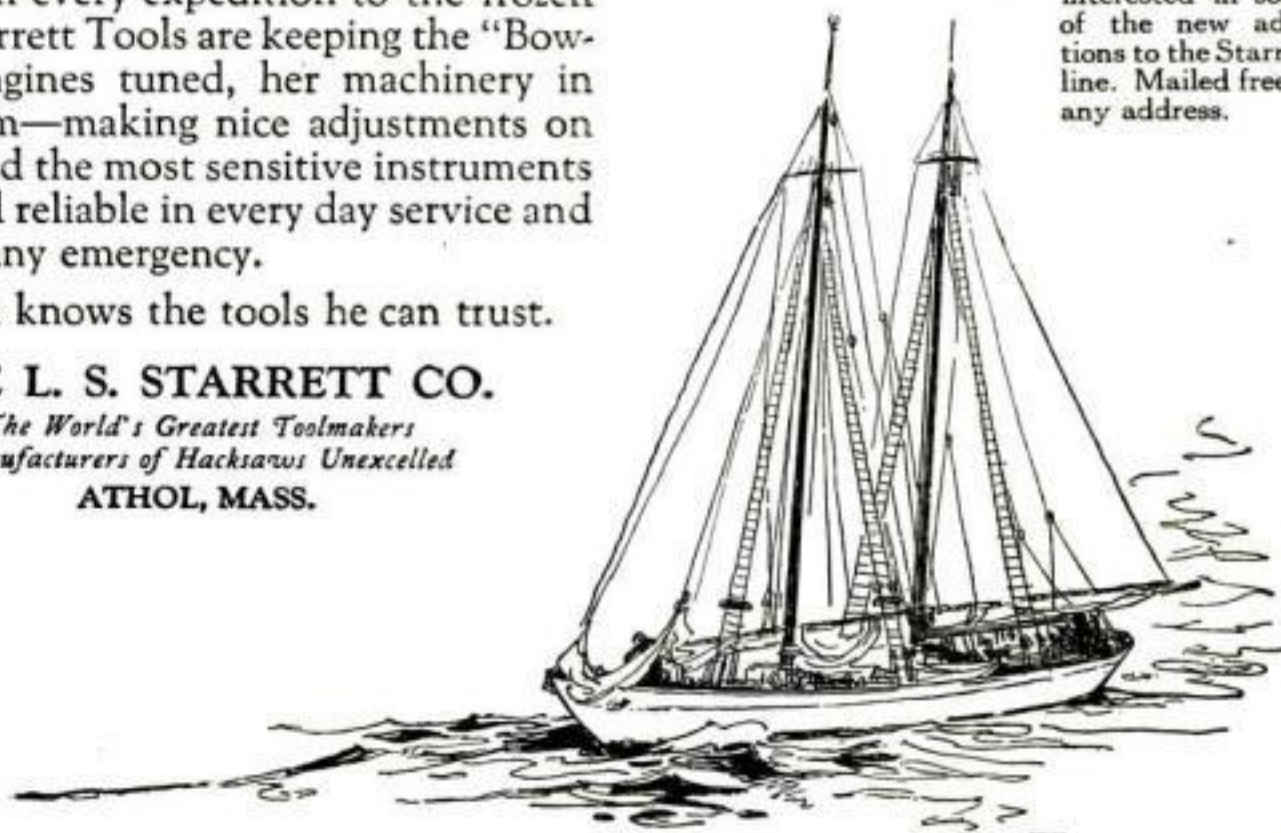
Starrett Tools accompany this world-famous explorer on every expedition to the frozen North. Starrett Tools are keeping the "Bowdoin's" engines tuned, her machinery in perfect trim—making nice adjustments on wireless and the most sensitive instruments—sure and reliable in every day service and ready for any emergency.

MacMillan knows the tools he can trust.

THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.

The Starrett Catalog No 22 "W" describes the tools shown in the photograph above (taken on board the "Bowdoin"). Send for this catalog showing over 2100 fine precision tools—you will be interested in some of the new additions to the Starrett line. Mailed free to any address.



Starrett Tools

The handy man's drill



MADE by skilled toolsmiths for men like yourself who appreciate good tools. Has two speeds, making it adaptable for work on all kinds of materials.

The all-steel chuck takes all sizes of round shank drills up to $\frac{3}{8}$ inch. Spindle runs in ball bearings. Malleable iron frame—steel pinions.

The polished rosewood handle is made to hold drills. Finished with a handy screw cap.

Handsomely enameled in black and red. Length, $14\frac{1}{2}$ inches; weight, $2\frac{1}{4}$ pounds.

Sold by good hardware stores everywhere. If your dealer hasn't it, write us.

Send for Catalog No. 15
Free to you

Illustrates and describes each of the Goodell - Pratt 1500 Good Tools. Your name and address on a postcard will bring your copy at once.

GOODELL-PRATT COMPANY

Toolsmiths

Greenfield, Mass., U. S. A.

No. 5½
Hand Drill
Price \$5.00

Mr. Punch says:

"Drilling a lot of holes has no terrors for the man who uses this Goodell-Pratt Hand Drill. It does its job so thoroughly that you'll consider it one of the best tool investments you ever made"



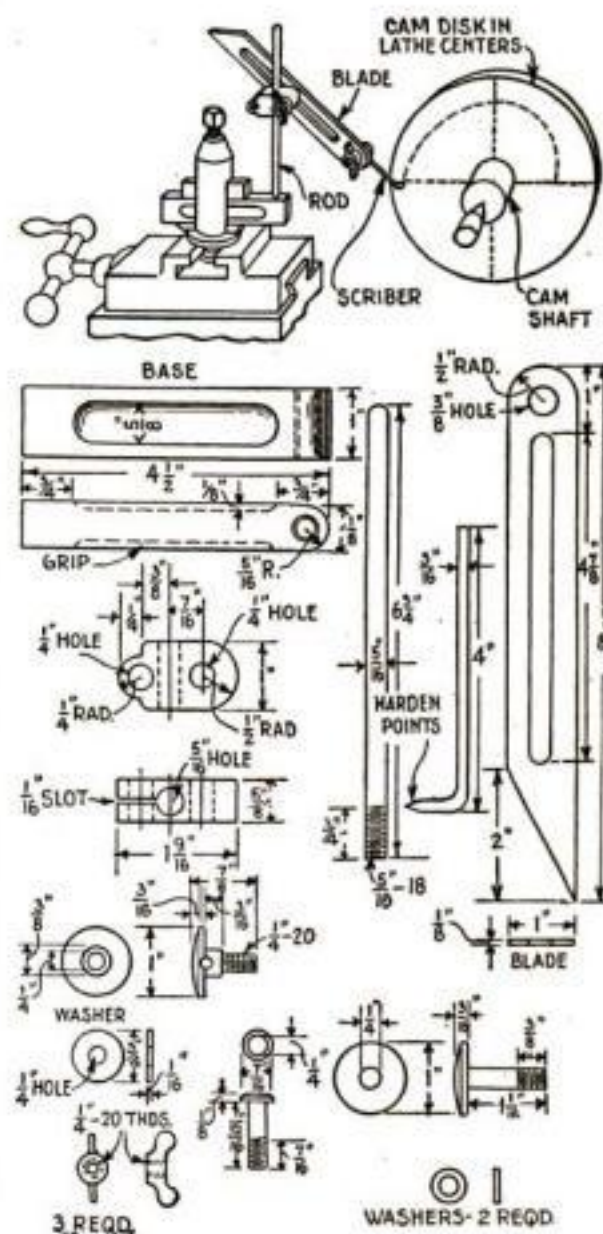
GOODELL-PRATT

1500 GOOD TOOLS

Machinist's Marker Saves Time in Laying Out Cams

FOR the mechanic who has to lay out cams, the tool illustrated is a time saver. It was designed by Mr. William Hanson, a toolroom foreman, and is constantly proving its value in actual use.

The tool can be held in the toolpost of a lathe and the cam disk held between its centers, or it can be placed on the cutter



This home recently completed at a total cost of \$9,690; owner has been offered \$15,000; built from National plans and specifications



How to Beat the High Cost of Building

There never was any better time to build a home. Get **STARTED RIGHT**: and your new house can be built just as you want it, for exactly what you plan to pay, and according to today's standards in modern construction. Use the **FREE** services of a nation-wide building organization; read the offer made here:

Good News For All Who Wish to Build a Home



"Local architects wanted \$500 for plans you supplied for \$40. Our house is ideal. Gratefully, W. S. B., Ohio."

If you have hesitated to tackle the building problem single-handed, here is your chance to secure expert advice and practical aid in every step of planning and erecting a home of your own. The National Homebuilders Society will make it pleasureable and profitable for you to build—now. The size and scope of this organization makes experiment unnecessary—failure impossible. From selection of the lot to the completed house—including every item of scientifically tested equipment; plumbing, heating, lighting, decorating and even landscape gardening; everything is covered; nothing is overlooked. You can have your home—build it now—have it on time—keep the cost within the estimate—and have every little detail of convenience, comfort, and attractiveness exactly as intended. Your local contractor can handle the job—your local dealers supply the material. They will welcome the standard service of this organization, because it makes the work twice as easy for all concerned.

192 Page Book Explains All

Our new book—The Homebuilder—is a mine of information for homebuilders; makes plain every point of selecting, financing, and building any kind of home you desire. Ready now!

Don't postpone building; don't compromise on a "ready-made" or "knock-down" house; a real home of artistic conception, proven practicability of arrangement, standard construction from foundation to roof is now easy to acquire—and without the waste that always occurs when untested specifications are used. Every National house has been built and finished, and labor and material checked to the dollar. There can be no "extras"! The big new book shows plans of over a hundred of these homes and photographs of the actual houses.

But the most valuable part of it all is the buying-power and building-power this book and the society's certificate put in your hands! It makes a new, modern, and desirable home practical and possible—to anybody!

SEND NO MONEY

All We Want Now Is Your Name

We can only hint here of the services which become yours to command from the day your application puts The Homebuilder in your possession. The best brains in architecture, construction, and equipment united in your interests, concentrated on your individual house—

down to the last detail.

Get this wonderful book of facts about home-building, and the countless ways this society aids you. Joining forces with us saves you time, worry, money. There are no dues to pay. You do not send a cent to get the book. Profusely illustrated—192 pages—plans—pictures—diagrams—every detail of design, construction, decoration of modern homes suited to any pocketbook. NOT a catalog, but a building guide. You may pay postman on delivery of book and certificate—only \$3 for everything, plus few cents postage! Or, if handier, send the three dollars now and receive package prepaid; money back if you say so!



"My home completed; the society's material lists saved me time, worry and money. H. S., Wisconsin."

Use Coupon Below



NATIONAL HOMEBUILDERS SOCIETY
(A corporation not for profit)
6 North Michigan Avenue, Chicago

I wish a week's free examination of The Homebuilder—your new 192-page illustrated building guide with plans, actual photographs and complete description of modern homes and their equipment—and certificate entitling me to full service privileges. I will pay postman \$3 plus few cents postage; this covers everything. (If more convenient, enclose \$3 now and receive package postpaid.) Money back if desired.

Name.....

Address.....

P. O. and State.....



Accurate Clean Cut Graduations

The second point of superiority of BROWN & SHARPE Micrometers

In the accurate clean cut graduations lies the second point of Brown & Sharpe Micrometers.

2

Did you see point 1 regarding the precision screw of a Brown & Sharpe Micrometer in last month's issue of this magazine? If not, ask for the booklet "The Micrometer" when you send for a No. 28 Catalog. Point 3 will appear in this magazine soon.

The first dividing engine to be used in America, for accurately graduating measuring tools was built by Brown & Sharpe in 1850. Seventy years of experience in accurately graduating tools together with the accurate machines which we have developed for this work give every Brown & Sharpe Micrometer graduations of superior accuracy.

Examine one of these tools at your dealers. Take particular notice of the graduation lines; they are clean cut, clear and straight and help produce the accurate measurements which mechanics look for and depend on in Brown & Sharpe Micrometer Calipers.

Write today for a copy of No. 28 Small Tool Catalog. It lists over 400 styles of Brown & Sharpe Micrometers.

BROWN & SHARPE MFG. CO.
Providence, R. I. U. S. A.

BROWN & SHARPE TOOLS

Make \$120.00 Weekly In Your Spare Time

Sell what the public wants—long distance radio receiving sets. Two sales weekly pays \$120 profit. No big investment, no canvassing. Sharpe of Colorado made \$955 in June. Representatives wanted in every county at once. This plan is sweeping the country—write today before your county is gone.

OZARKA, 801 Washington Blvd., Chicago

Free GET MY FREE BOOK TODAY
The Right Way to Sell
You Too, Can Earn
\$4,000 to \$15,000 a Year
Selling offers you biggest jobs—astounding opportunities. I will train you and help you get the big job, free. Don't think you can't sell. I'LL SHOW YOU HOW.
Write Today for FREE Book "The Right Way to Sell"
JAS. P. WARD, General Sales Manager
MANUFACTURERS' SALES CORP. OF AMERICA
5547 Administration Bldg., 2724-N. Broadway Ave. Chicago, Ill.
"THE MAN WHO MAKES MONEY MAKERS"

Agents—Here It Is

The New Serenola



Something new and different. Something you can sell easily and quickly. Orders waiting everywhere. Baird sold 23 in one week, his profit over \$150. The Serenola is built in just like a suitcase. Carried with you anywhere. Does more than machines costing 5 times its price.

Fully Guaranteed

Get started at once. No experience needed. We deliver and collect. Pay you every day. Work full or spare time. Write or wire us for terms and territory.

PERRY-LUDLOW CO., S-1847 Dayton, Ohio

Only \$1000 to \$3000 Starts You in Business

We want a few men who have made good—to take charge of our distributing branches, to direct the men already at work, hire others, and fill orders quickly. We make the nationally advertised

AIR-GAGE Inner Tubes

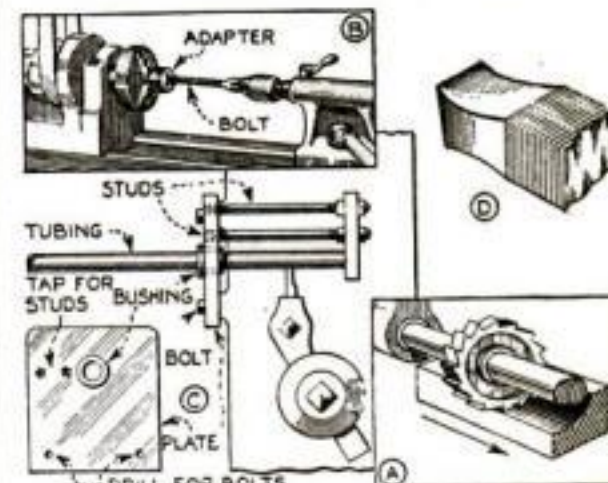
Air Gauge in valve stem of each tube shows pressure at a glance. Sells on sight to car owners. Agents make big money, 4000 at work. If you can qualify as Branch Distributor, write at once and we will arrange for you to come to factory at our expense. Then you can decide. M. W. McConnell, President, PAUL RUBBER CO. 54 Paul Heights, Salisbury, N. C.

Some Machine Shop Kinks I Have Found Useful

By H. W. Bente

IN MILLING down a steel block recently, I found the $\frac{5}{8}$ by 6 in. side cutter I was using—the only one available—chattered very much in taking heavy cuts. By working the cutter sideways against the work, as at A, I was able to proceed much faster and overcome the chattering entirely. Care must be used, of course, not to overcrowd the work and break the cutter, but as an emergency trick, this is entirely satisfactory, especially in a small shop where a machinist is often called upon to do a greater variety of work than he is properly equipped for.

The reverse belt of a lathe is invaluable at times. For instance, I had about fifty



A milling kink (A), using the reverse belt on a lathe in threading (B), cutting off bushings from tube stock (C), and a lathe roughing tool (D)

4-in. rods to thread, and only a single die to work with. By making an adapter to hold the die and placing it in the spindle of the lathe, as at B, holding the other end of the bolt in the tailstock, I ran the lathe the right way to thread and used the reverse to back it out again.

Another "kink" that has worked well is the method of cutting off small bushings from brass tube stock, illustrated at C. On most lathes will be found two tapped holes for the so-called follow-up steady rest. They are usually on the side of the cross carriage nearest the spindle. In this case they were used for attaching a cast iron plate having a hole bored in it in line with the hole in the lathe spindle. To accommodate several sizes of stocks, several bushings were made with holes of the correct sizes. Each of these bushing adapters has a shoulder that comes up solidly against the plate to prevent the tubing from pushing it through the plate. On the cut-off side of the plate are two studs holding a short piece of flat cold rolled stock to serve as a guide for the correct length.

For roughing work on a lathe, I have a method of grinding the tools that would, I believe, be hard to beat. It requires less power than usual, and I have often been able to take a cut the full width of the tool running on the open belt. The tool is ground straight across the face, as shown at D, with the amount of clearance depending upon the size of the work at hand. It has a lip at the top to cause the chips to curl up and roll away from the tool, thus reducing the amount of friction.

A little suggestion that comes to my mind is in regard to dressing an emery wheel for putting a fine finish on a tool: Hold an ordinary oilstone against the wheel after the wheel has been dressed with the regular emery wheel dresser.

Are You Musically Inclined?

Gibson
MASTERTONE
TENOR BANJO

A masterpiece of workmanship, design, finish and tone. Easy to play and keep tuned, short scale, oval frets, light weight, completely equipped. Features floating head, ball bearing contact, air chambers tuned to pitch, correct voicing, high bridge, co-ordinator, tone projector.

Make \$2,000 to \$5,000 a Year
Player-agents wanted; organize orchestra; we help you receive commission. Small payment, then \$5.00 a month pays for a Gibson; brings wholesome year-round entertainment profit. Guaranteed for life.

Gibson **Easy to Play**
Easy to Pay
"Music Basis of the Nation"
Liberal allowance on old instrument in exchange for a Gibson.
Mandolin, Mando-bass, Mandolin-banjo, Guitar, Tenor-banjo, Mando-cello, Harp-Guitar, Cello-banjo, Guitar-banjo.
Write today for free book, catalog, free trial offer, stating the Gibson you prefer.
Gibson Mandolin-Guitar Co., 1530 Parsons St., Kalamazoo, Mich.

Radio Catalogue Free—

**Write us
a post card—**

and we will send you free this 52 page catalogue of radio sets and parts. It also contains explanation of radio terms, map and list of broadcasting stations and much radio information, including an explanation of successful hook-ups and circuits.

You will be amazed at the low prices Ward's quote. A complete set for \$32.50 equalling sets at \$60 elsewhere—a \$23.50 set that under favorable conditions has a radius of 500 miles and more.

This catalogue contains everything for the expert and amateur. Complete sets and every improved part for building sets, all the most up-to-date devices—at the lowest possible prices.

Headquarters for Radio

Montgomery Ward & Co. is headquarters for Radio, selling everything direct by mail without the usual "Radio-profits." Why pay higher prices? Ward quality is the best and the prices will often save you one-third. Everything sold under our Fifty Year Old Guarantee,—Your Money Back if You Are Not Satisfied. Write today for your copy of this complete 52-page Radio Book.

Write to the house nearest you. Address Dept. 5-R

Chicago Kansas City St. Paul Portland, Ore. Fort Worth

Montgomery Ward & Co.

≡ The Oldest Mail Order House is Today the Most Progressive ≡



Three Tubes Is All You Need



With Erla Synchronized Transformers



Perfect synchronization of Erla transformers assures unequalled range and volume, with no trace of distortion. Cascade \$4. Reflex \$5



One of the most notable improvements of recent years is disclosed in the new Erla synchronized audio frequency transformer. List \$5



Especially constructed for reflex work, the Erla fixed crystal guarantees success. Proof against disturbance through jolt or jar. List \$1



Every Erla fixed condenser is individually tested to the exact capacity shown, an exclusive feature. Made in eleven sizes, 35c to \$1

Transcontinental reception, through a loud speaker, is assured when you tune in with the new Erla Triplex circuit, using three vacuum tubes and Erla synchronized radio frequency and audio frequency transformers.

Results obtained surpass conventional six and seven-tube circuits in range and volume. Moreover, tone quality is remarkably improved, with complete absence of the parasitic noises common to hook-ups less advanced.

For all except the most distant stations, outdoor antenna can be dispensed with, an inside aerial serving equally well. Wet batteries, likewise, are no longer essential, low current consumption enabling satisfactory use of dry cells.

Accounting in large measure for the amazing efficiency of this circuit, and guaranteeing its successful operation, are Erla synchronized radio and audio frequency transformers. For the first time, perfect inter-relation and co-ordination between transformers has been secured in reflex work, producing unequalled amplification without distortion.

A further notable contribution to radio improvement is embodied in the new Erla fixed crystal detector. Providing maximum sensitiveness and purity of reception, with complete freedom from disturbance through jolt and jar, it antiquates the costly vacuum tube for detector purposes. Detailed working diagrams and descriptions of the Erla Triplex and other advanced Erla reflex circuits are included in Erla Bulletin No. 14, obtainable gratis from leading radio dealers. Or, if your dealer should be unable to supply you, write us direct, giving your dealer's name.

Electrical Research Laboratories
Dept. F. 2515 N. Michigan Ave., Chicago

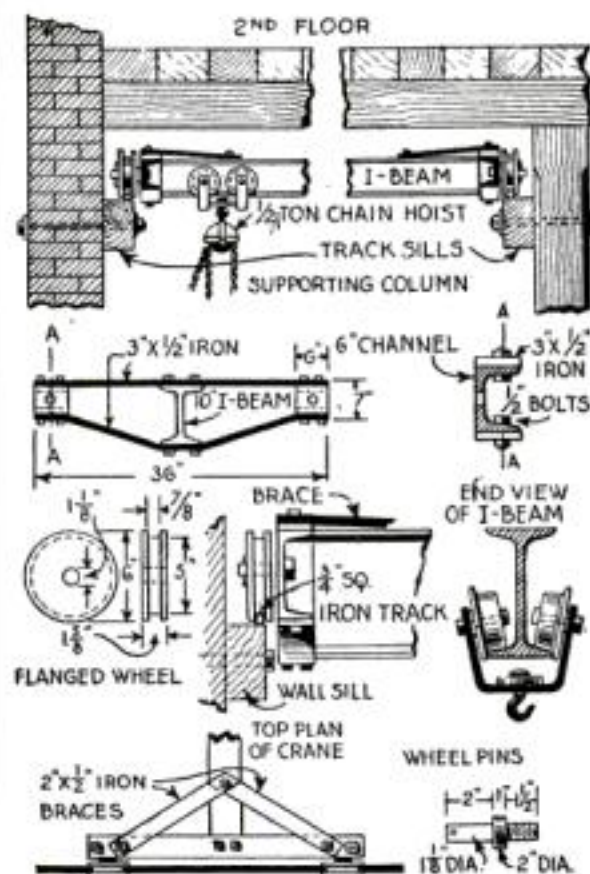
ERLA

How to Build an I-Beam Garage Crane

THE universal I-beam garage crane illustrated can be built at minimum expense in any garage repair shop. It is fabricated mainly of standard steel or iron shapes, and most of the work consists merely of drilling and bolting the parts together.

Wall sills are bolted to one wall and to the opposite wall, posts or other supports, as shown. These should be sound 4 by 6 in. yellow pine or other strong wood, and supported with bolts every 3 ft. along the wall. Tracks of 3/4-in. square iron are fastened to these sills with countersunk wood screws spaced 12 in. apart.

The crane proper is a section of 10 inch I-beam to which traveling ends are at-



How the parts of the track and trolley are made and the way they are assembled

tached, as indicated. The beam forms the bridge and trolley track for the chain hoist.

The end carriages are 1/2 by 3-in. flat iron or steel, the top piece being straight and the lower piece bent to the form shown. At each end these pieces are bolted to a 6-in. length of 6-in. channel iron and the channels are drilled to take the pulley shafts, which are turned of round, cold rolled steel. The flanges butt against the channel iron and are held in place by a nut on the rear.

The wheels are cast iron, machined with 3/8-in. grooves to fit freely on the 3/4-in. track. Oil holes are drilled for lubricating the bearings. Braces of 1/2 by 2-in. iron keep the end carriages firm and square. The trolley can either be purchased already assembled or made up in the shop along the lines shown.—J. R.

Estimating Weight of Castings

A HANDY method for a foundry to determine what quantity of steel or brass to pour to complete any number of castings is to stamp the weight of the casting on the pattern. Where this is not practical, the same result can be obtained by figuring that a steel casting weighs 16 times as much as its pattern in white pine, and a brass casting 18 times. From 10 to 20 per cent extra should be allowed for fins and risers.—F. M. S.



HEAD PHONE CUSHION
(NUDEON-POSS)

FANS List of Bargains **FREE**

RADIO BARGAINS
17 N. LA SALLE ST. - CHICAGO

MAKE MONEY AT HOME

YOU CAN earn \$1 to \$2 an hour writing show cards at home in your spare time. Quickly and easily learned by our new simple "Instructograph" method. No canvassing or soliciting. We show you how, guarantee you steady work at home, no matter where you live, and pay you cash each week. Full particulars and booklet free. Write to-day.

AMERICAN SHOW CARD SYSTEM LIMITED
Authorized and Fully Paid Capital, One Million Dollars.
206 Adams Bldg. Toronto, Canada.



Six Machines in One

Saw, Sander, Drill, Grinder, Polisher and Buffer

Boice Pony Bench Machine

A decidedly practical, extremely compact, precision machine. Height 10". Handles 4" and 5" grinding wheels; 6" saws; 6" and 8" sand discs; 3/8" chuck. Top, 10"x12", easily removable. Saws up to 1 1/2" stock. Easily driven by 1/4 or 1/3 h.p. motor.

BOICE-BUILT Machines are in daily use in hundreds of shops. Their size, absolute accuracy and low cost provide a means for producing a better job for less money. Boice saws are made in six models—are portable and attach to any light socket.

W. B. & J. E. Boice, Dept. P.S. 10, Toledo, Ohio

Write today for descriptive literature on this and other BOICE-BUILT Bench Machines and Motors.

No wireless receiving set complete without

Magnavox Radio

The Reproducer Supreme

IT has been the dream of every Radio user to own in one unit a Power Amplifier and electro-dynamic Reproducer, thus insuring perfect Radio reproduction.

After exhaustive study and tests by our engineers, this has been successfully accomplished, and the new instruments of the unit type here illustrated in one and two stages of amplification may now be had through Magnavox dealers everywhere.

There is now a Magnavox for every receiving set. The full line embraces:

Magnavox Reproducers

- R2 with 18-inch curvex horn . \$60.00
R3 with 14-inch curvex horn . 35.00
M1 with 14-inch curvex horn.
Equipped with binding posts
and a five foot flexible cord;
requires no battery for the field. 35.00

Magnavox Combination Sets

- A1-R consisting of electro-dynamic
Reproducer with 14-inch curvex
horn and 1-stage of amplification 59.00
A2-R consisting of electro-dynamic
Reproducer with 18-inch curvex
horn and 2 stages of amplification 95.00
Special: with 14-inch curvex
horn as illustrated . . . 85.00

Magnavox Power Amplifiers

- A1—new 1-stage Power Amplifier 27.50
AC-2-C—2-stage Power Amplifier 55.00
AC-3-C—3-stage Power Amplifier 75.00

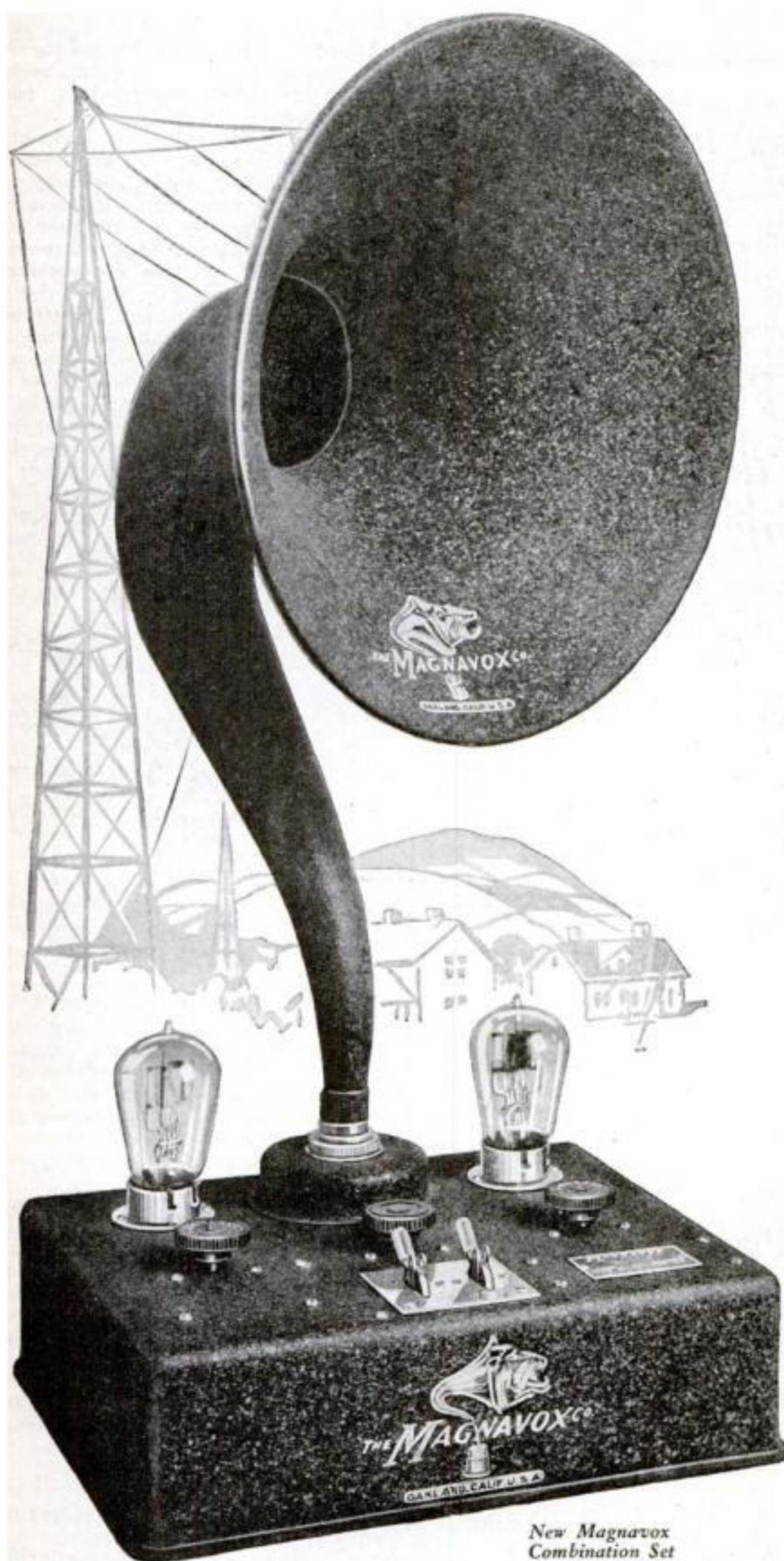
Magnavox Products can be had of
good dealers everywhere. Ask for
a demonstration.

THE MAGNAVOX CO.

OAKLAND, CALIFORNIA

370 Seventh Ave., New York

*World pioneers in the development and manufacture of
sound amplifying apparatus*



*New Magnavox
Combination Set*

A2-R insures convenient and
perfect Radio reproduction.
Designed especially to meet the
requirements of receiving sets
used in the home.

Magnavox Reproducers and Amplifiers



Tuska Popular No. 225

3-bulb Regenerative Receiving Set. Piano finish mahogany cabinet. Amplifier switch. Concealed binding posts. Armstrong circuit, licensed under Patent No. 1,113,149. Price \$75, without bulbs, batteries or loud speakers. Ask for special circular No. 19B, describing this set.

*Let the
day's troubles
sink with the sun*

THEN turn to your Tuska Radio, and be whisked around the world. A touch of the dials, and you are in Davenport. A slight movement brings you to Philadelphia to hear the majestic music of the greatest organ. Or *anywhere* you please to go. In those precious hours between work and sleep, you live in Radio Fairyland, where you are master of distance and ruler of a host of entertainers.

Will you give your family the pleasure of Tuska Radio, which educates, soothes, amuses, and takes you traveling inexpensively? Here is the receiver that annihilates miles; bringing in music and voices sweetly, clearly and undistorted. It is the ideal set for busy people who want the thrills of radio without the tinkering.

For 12 years, Tuska Radio has been famous for advanced design and painstaking New England workmanship. The Tuska receiving set of today is not only up-to-date; it will still be serviceable in five years.



THE C. D. TUSKA CO.
Hartford, Conn.

TUSKA RADIO

Standard Spanish ARMY

Used by French
During World War

Buy direct from sole U. S.
importers and SAVE ½ on this

GENUINE ASTRA AUTOMATIC

The Ideal gun for home protection—Just right for a woman to use. You can save about ½ at these special prices. Order direct.

- \$7.75** 25 calibre—7 shot—C. O. Q. Automatic.
8.95 25 calibre—7 shot—Astra Automatic.
9.95 25 calibre Astra with triple safety.
10.95 32 calibre—10 shot Astra, extra magazine.
16.95 32-20 and 38 cal. swing-out cyl. revolvers.

We guarantee every gun against defective workmanship; brand new; of Drop Forged Steel Through-out. Before buying any weapon **INSIST** on this guarantee. **SEND NO MONEY** unless you wish. State model desired—pay postman on delivery plus postage. Satisfaction guaranteed or money refunded. Write for new firearms catalogue.

CALIFORNIA TRADING CO.

Dept. 110, Terminal Bldg., Los Angeles, Cal.



\$25.00 IN PRIZES

See top of page four in front of book for details

The MONARCH Jr. Lathe

Is Priced Within Your Means

Most efficient machine tool you can have in home workshop, repair shop or garage too. Turns out, with 1000th-inch accuracy, all small wood and metal parts that other lathes will. Experimenters, inventors, mechanics enthusiastic over it. Completely equipped; auto. safety devices; semi-quick change gear.



9" lathe—
2½ ft. bed—
with bench legs
\$245

Also built with bed lengths up to 5 feet. Made in 11-inch swing size too, at slightly higher price.

THE MONARCH MACHINE TOOL CO.
401 OAK STREET SIDNEY, OHIO

Time-Tested Tricks in Casting Babbitt Bearings

By Joe V. Romig

Machine Tool Designer and Builder

WHILE all machinists are more or less familiar with the use of Babbitt metal, there are, nevertheless, many tricks that make the work easier.

Babbitt metal is ordinarily a combination of three or more of the following metals: tin, lead, bismuth, antimony, and copper. Those mixtures with the largest content of tin usually cost the most.

If you wish to mix your own, place a ladle on a good fresh coal fire and throw into it the metal having the highest melting point. When this has melted, add the next highest, and so on until all are melted and fused together. Stir well with a wooden paddle or iron rod before pouring into the pig molds to cool. If copper is to be added to the mixture, it must be melted in a small separate crucible, and poured into the batch and stirred well just before removing the Babbitt metal from the fire. In order not to lose any of the high priced metals through oxidization, the metal



Goggles and a handy lump of clay will reduce the danger of accidental burns

should not be heated too much or be kept at a high heat too long. If, for any reason, a ladle must be kept going for the casting of many small pieces, the top surface of the molten metal should be protected by a sifting of finely pulverized charcoal dust. This will keep off the air and can be brushed or skimmed aside readily when pouring.

Before pouring a bearing, always stir the metal well. Invariably copper will rise to the top, and this valuable metal usually is lost when an inexperienced mechanic does the pouring. Use a wooden paddle or iron bar to run or douse the top dross beneath the surface, as that is the only way in which the copper can be saved. Rather than skim off the dross, push it to one side; when you have finished pouring, this same coating again will cover the surface and prevent a new coating from forming.

To make Babbitt metal pour freely, throw in a small amount of powdered rosin, and stir well, immediately before pouring. Rosin will also keep down the gas formation and should always be used when pouring into a moist or sweating bearing.

Excessive heat "kills" Babbitt metal and makes it harsh and brittle. A good test is to pour when the metal is hot enough to ignite a dry pine stick or sliver. This temperature is the best except when pouring into extensive, shallow cavities or deep and intricate recesses.

(Turn to page 90)



\$200
per week

\$150
per week

\$100
per week

\$75⁰⁰
per week

\$50⁰⁰
per week

\$25⁰⁰
per week

\$20⁰⁰
per week

\$18⁰⁰
per week

Get The Pay of the Man Higher Up!

You are not the kind of man who is always going to take orders from others. What you want is to **give**—not **take** orders. You want the bigger pay that goes with that kind of work; and here in this great Library of Practical Books for Self-training, you are offered the sure way of getting what you want.

In these books you will find a wealth of the very information you need to **GET MORE MONEY** in the trade you are following. There are thirteen sets, each set devoted to one particular line of work. Each set is written by a group of highly trained practical experts who cover the entire subject from a technical standpoint yet do it so clearly and illustrate everything so plainly with diagrams and blue prints that you can't fail to understand every word.

Thousands of men who have read and studied these books have gained by it. If you were to get only one idea that helped you prove an **UNUSUAL** knowledge of your work, that one idea would be worth what a dozen sets would cost you. Every book is simply packed with such ideas and helpful information.

Reference Books That Make Happy Days of Pay Days Select Your Own Line From This List for Week's Free Use

5 vols. Carpentry and Contracting— was \$37.50 now.....	\$19.80	8 vols. Business Management—was \$52.50 now.....	29.80
12 vols. American Law and Practice (including free reading course and 250 page book of standard legal forms)—was \$97.50 now.....	49.80	7 vols. Steam and Gas Engineering— was \$52.50 now.....	24.80
8 vols. Applied Electricity—was \$60.00 now.....	29.80	4 vols. Sanitation, Heating and Ven- tilating—was \$30.00 now.....	14.80
6 vols. Auto Engineering—was \$45.00 now.....	21.80	4 vols. Fire Prevention and Insurance— was \$30.00 now.....	14.80
9 vols. Civil Engineering—was \$67.50 now.....	34.80	6 vols. Modern Machine Shop Practice —was \$45.00 now.....	21.80
		4 vols. Telephony and Telegraphy— was \$30.00 now.....	14.80
		4 vols. Drawing—was \$30.00 now.....	14.80

Free Consulting Membership

A resident consulting staff of from 15 to 20 practical experts is waiting to solve for you any difficulty that you may have. A letter or a wire to American Technical Society will bring you an immediate answer and the solution to your problems. This advisory staff of practical men plus your working and reference library will enable you to handle successfully any job in your line. These men know all the latest methods and the newest and best ways of doing things. Let this pay-raising consulting staff be **YOUR SILENT PARTNER**. Use this service daily if necessary.

This free consulting membership offer is good for a limited time only and can be withdrawn without notice.

Use Books FREE For One Week—Send No Money

—just fill out the coupon. After you receive the full set of books, express collect, read them over and test them out for seven days. If you don't want them, send them back at our expense. If you decide they will do for you what they have done for more than 200,000 others, pay \$2.80 within one week and \$3.00 each month thereafter until the special price is paid. **This amounts to only ten cents a day.** Mail coupon **NOW** if you want a bigger, better job at higher wages.

Here's your opportunity, if you want to **EARN MORE MONEY**. Remember, we are taking all the chances—you pay **NOTHING** unless you are absolutely satisfied after seeing the books. Isn't this about the fairest proposition that was ever put up to you?

American Technical Society
Dept. X-720 Chicago, U. S. A.

© A. T. S. 1923

AMERICAN TECHNICAL SOCIETY, Dept. X-720 Chicago.	
Please send me a set of.....for seven days' FREE EXAMINATION, shipping charges collect. I will examine these books thoroughly, and if satisfied, will send \$2.80 within seven days and \$3.00 a month until I have paid the special price of \$..... If I decide not to keep the books, I will return them within one week at your expense. It is understood that if I keep the books I am entitled to a FREE Consulting Membership in the Society.	
Name	Address
Reference..... (Please fill out all lines, give local merchant, banker or employer as reference.)	

INTRODUCING Millers Falls Radio Hand Drill No. 85

RADIO is here to stay. Every day thousands join in the thrilling sport of picking entertainment from the air. And as every one knows, half the fun of getting a radio outfit is putting it in yourself. The Millers Falls workmen are radio fans, too. They have just produced a radio hand drill—No. 85—so good that no one can afford to be without it—so reasonably priced that every one can easily afford to buy it.

This drill has $\frac{1}{4}$ -inch chuck capacity and takes all twist drills used in radio work. Black enamel frame—gear enameled red. See it at your hardware dealer's. You'll say it's a beauty.



**MILLERS
FALLS
COMPANY**

Millers Falls, Mass.

Manufacturers of Carpenters'
Tools, Hack Saws and
Automobile Tools.

**MILLERS FALLS
TOOLS**

SINCE
1868

Tricks in Babbitting

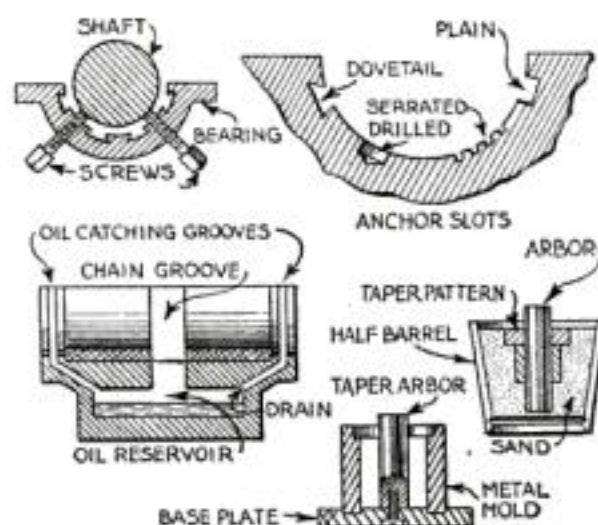
(Continued from page 88)

When possible, the bushing or bearing to be poured should be heated first so as not to chill the hot metal, as chilling has a tendency to crack the metal and causes abnormal shrinkage. Pour steadily and as fast as the gas formation will permit, and do not stop, as a stop will result in a lap or crack. When pouring large bearings that require several ladles, have them all hot and ready.

To make Babbitt metal hold in half circles and on flat surfaces, a system of grooves or slots is required as an anchorage. The surface of brass or bronze metal bushings sometimes is tinned with a half and half solder; this causes the poured Babbitt metal to unite perfectly. If a bearing is to be poured and no other provision has been made for anchorage, a drill is used to make shallow depressions, as shown. These shallow holes ordinarily should be only about $\frac{1}{4}$ in. deep and of the same or larger diameter, and should be spaced 1 in. apart. Grooves can also be chipped in the bearing pads with a cape chisel. Dovetailed grooves, slanting holes, or tapped holes must be used on flat surfaces.

Bearings are babbitted to size or, if smaller, bored to size. Rough work, where the accuracy of alinement and size is not important, is always babbitted to size. An old machine shop saying is that "the skin of the metal will be worth more if left unscraped than $\frac{1}{2}$ in. of the metal beneath," the logic being that the surface skin is the densest and toughest, and therefore will wear and last much longer than the metal below.

In order to withdraw an arbor and prevent it from sticking, every one uses either oil, smoke, or paper in some form. Oil really should not be used, as it gases too much and causes bubbles in the surface of



Alining and supporting a shaft, making anchor slots, a typical babbitted box, and sand and metal molds

the poured metal. Heavy white lead, smeared on thinly and evenly, is perhaps the best for all around purposes. A single thickness of thin paper, either held with strings or with ends lapped and glued, will provide clearance for rough work.

Smoking the surface of the shaft with an oil torch will give a fine, dry surface, which does not gas at all, and the deposit of lamp-black permits the easy removal of the shaft. Painting the shaft with clay, mixed to a thin solution with water, is another method sometimes used.

Where accuracy is necessary, the bearing must be bored and reamed to size. Large bearings that are to be bored to size are usually peened. The hammering makes the

(Continued on page 91)



"Red Devil" Rapid Boring Auger Bits are $3\frac{1}{2}\%$ easier boring, have 10% greater clearance and bore with or against the grain of any wood. Style 2420—10 1/16 in. shown here, 75c.

Red Devil Reg. U. S. Pat. Off. Mechanic's Snips

YOU need a pair in the tool chest. You never know when you may have use for them.

For roof repairs, soldering jobs, for cutting tin, sheet zinc, sheet iron or copper, stove pipe, window screen wire, and for kindred work, you will find "Red Devils" mighty handy to have around.



"Red Devil" Snips will enable you to do many things for yourself that you would otherwise pay to have done.

Built of the best tool steel. Designed to cut with the least effort and stay sharp. Size 7 inches long.

"Red Devil" Snips No. 578—at all good hardware dealers, or if not in stock, send 90c. and dealer's name for a sample tool.

The "Red Devil" Mechanic's Tool Booklet is a handy reference guide for users of good tools—send for it—it's free.

SMITH & HEMENWAY CO., Inc.
Manufacturers of "Red Devil" Tools
264 Broadway New York, N. Y.

"Red Devil" Glass Cutters—the glaziers' standard tool of the world. "It's all in the wheel." Made in 40 styles, No. 024 shown here, 20c.



Tricks in Babbitting

(Continued from page 90)

surface metal denser and also closes up any laps or cracks. Peening is to be recommended wherever possible. On solid bearings that are to be bored, an arbor is sometimes run through the hole on a press.

Heavy cardboard and thin wood are used to close the open ends of a bearing, the pieces being cut to fit the shaft. These pieces must then be luted against the metal of the bearing. Clay of doughlike consistency forms the ideal luting material. Some use putty, but even when used in a thick or semihard condition, it will soften and run under the heat of the molten metal. Clay sets and hardens quickly and can be dried artificially with a blowtorch. Wooden dams are also used and must, indeed, be employed when the amount of metal is large and where the fall in level due to shrinkage is great.

On common chain or ring oiling bearings, the shaft can be supported on duck or hemp packing rings, the rings being cut to the proper width and placed in the oil drain grooves. When babbitting such a bearing, fill the oil reservoir and passages with fine sand, and top off all the exposed sand with a $\frac{1}{4}$ -in. layer of clay. Many a Babbitt "mine" has been poured by sticking cotton waste in a cavity and expecting it to hold back the hot metal.

When luting up the dams and crevices of a bearing, prior to pouring, it is a good stunt to place twisted strands of cotton waste in all of the crevices, as when the hot babbitt hits the waste, reinforced as it is by clay, it will stop, and by not coming in actual contact with the wet clay, will not generate any steam or gases. When pouring any bearing metal, always have a ball or two of clay lying handy for use in case of a broken dam or leak. The ball allows one to close a leak without the danger of burns.

When pouring a half bearing, level up both arbor and shell, and build a dam on each side at least $\frac{1}{2}$ in. higher than the flanged surface of the bearing. This will provide for the shrinkage and will leave no sunken edge.

Castings small in size can be made in wooden molds, preferably dry, soft white pine. Bushings, thrust rings, and the like also can be cast in the rough in either an iron mold or in sand. When casting Babbitt metal in sand, first wet the sand with kerosene and then add enough water to make it ball up in the hand.

Metal molds should always be bored with a generous draft, and arbors for solid work also should have a good taper. All arbors should be clamped in place to avoid floating.

Labor Saving Features to Appear Next Month

A SIMPLE fixture that takes the guess out of dressing grinding wheels to accurate radii will be described by Henry S. Laraby in the November Better Shop Methods Department.

Joe V. Romig will have one of his characteristic "Old Bill" stories on how a typical old-time machinist taught him to speed up his work. This will be followed in another issue by a remarkably helpful article on laying out work.

NICHOLSON
U.S.A.
(TRADE MARK)

The Files That Belong in Every Tool Box

RIGHT TOOLS and right methods are prime essentials of good work. Neither the tools nor the methods alone suffice. The combination wins!

Training, practice and experience will teach you the methods of using files. The following NICHOLSON Files, because of their sharper cutting accuracy, finer temper and edgeworking endurance, have earned places in the equipment of the best workmen everywhere:—

3½" Slim Taper File	4" Warding Bastard File
6" Slim Taper File	6" Warding Bastard File
6" Half Round Bastard File	6" Hand Smooth File
8" Half Round Wood Rasp	10" Flat Bastard File
6" Round Bastard File	8" Mill Bastard File
6" Square Bastard File	10" Half Round Bastard File

Be sure the name NICHOLSON is stamped on the file you buy

NICHOLSON FILE ©
PROVIDENCE, RHODE ISLAND



NICHOLSON FILES
~a File for Every Purpose

For Every Ford Job



MOSSBERG

Chrome Manganese Steel Wrenches and Tools

For every possible Ford job. Upstanding, two-fisted wrenches that are built to withstand the hardest work—day-in-and-day-out.

Examine the nearest stock of Mossberg Wrenches for Fords. You will find their construction superior to any you have seen. Their prices represent real value. Every Mossberg Wrench is made of Chrome Manganese Steel. Every wrench or tool is built to do a particular job—in the quickest, surest, easiest way.

Ask to see No. 654 Valve Lifter, Set No. 1944—"8 wrenches in 2" and other Mossberg leaders.



No. 654 Valve Spring Lifter for Fords



No. 1944 "Double Four" Socket Set
—2 Wrenches, 8 Openings

FRANK MOSSBERG CO.
Lamb Street, Attleboro, Mass.

Building a Kitchen Cabinet Work Table

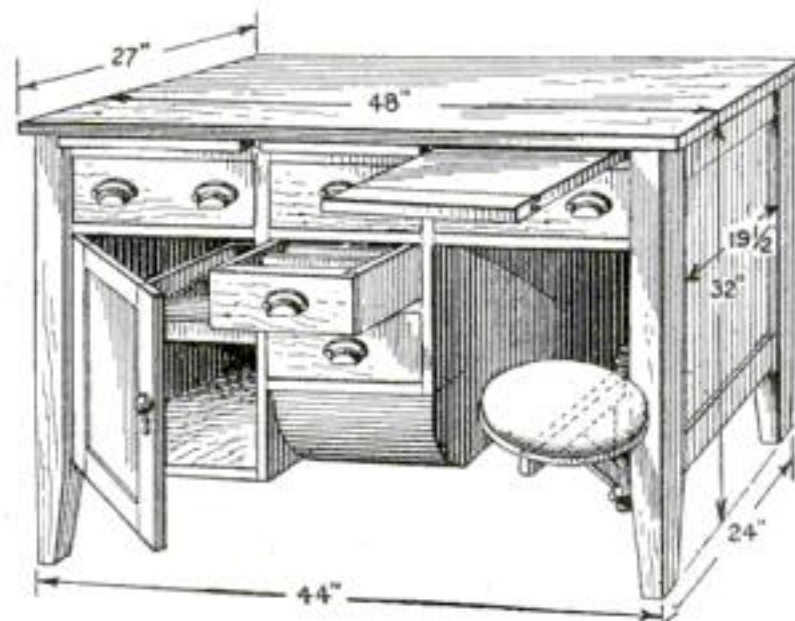
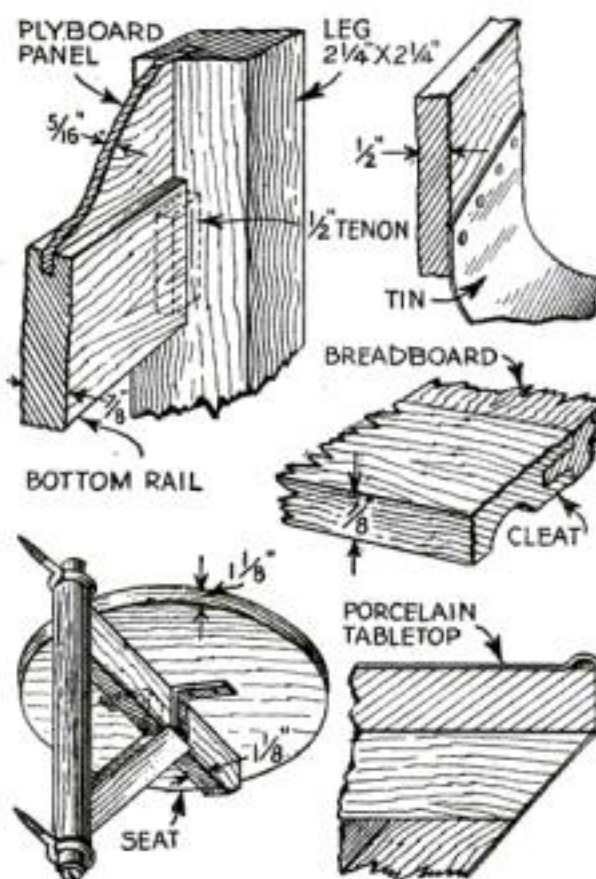
WHAT a workbench is to a shop, a kitchen table cabinet is to a kitchen. If properly designed and well made, it is a constant saver of the housewife's steps, time, and labor.

This kitchen work table—fully detailed in POPULAR SCIENCE MONTHLY's Blueprint No. 27—can be built at a moderate cost for materials by any home worker who is handy with woodworking tools, and will give service equal to, if not more satisfactory than the average expensive table cabinet sold in department or furniture stores.

All the available space beneath the table top is utilized. There are three breadboards, four drawers—one partitioned for knives, forks, and spoons—a large bin drawer, a cupboard with two sliding trays, and a seat. The top may be either wood or a wooden frame with a commercial porcelain top, as preferred. The essential dimensions and main details are made clear in the accompanying illustrations.

Several modifications may be made, if desired. For instance, if so much drawer space is not required, the bin drawer and the drawer immediately above it may be omitted. This gives more knee room and makes the table somewhat more comfortable if much work is to be done sitting down. If it is preferred to use a stool or chair in place of the swinging seat, the seat can be left off.

While the seat can be constructed easily, care must be taken to make the pivot from stock not less than $1\frac{3}{8}$ by $1\frac{3}{4}$ in. or $1\frac{1}{2}$ in. in diameter, the arm $1\frac{1}{8}$ by $1\frac{3}{4}$ in. and the brace $1\frac{1}{8}$ by $1\frac{1}{2}$ in. They must be of carefully se-



The general construction and some of the more important details of the kitchen cabinet work table. Full working details are contained in POPULAR SCIENCE MONTHLY's Blueprint No. 27



lected hard wood to insure the necessary strength. Even then, if a heavy person is to use the seat, it should be fitted with a supplementary foot made of a $\frac{3}{8}$ - or 1-in. dowel, and attached at the outside end of the cross arm. This leg should be fitted with a caster so that it will slide over the floor easily when the seat is turned in and out. This takes much of the strain off the $2\frac{1}{2}$ -in. screweyes and the table leg.

Ordinarily, the pivot would be simply a piece $1\frac{3}{8}$ by $1\frac{3}{4}$ by 13 in., well rounded on one edge and with round pins turned at each end, but a heavy curtain rod may be used, if available, or, if a lathe is at hand, it may be turned throughout as shown, and the other pieces fitted neatly to it.

Standard woodworking construction is followed throughout. The rails are tenoned into the legs, but may be doweled, if the maker prefer.

The legs are $2\frac{1}{2}$ by $2\frac{1}{2}$ by $31\frac{1}{8}$ in.; the four top and bottom end rails, $\frac{7}{8}$ by 4 by $20\frac{1}{2}$ in.; and the end panels, $\frac{5}{16}$ by $20\frac{1}{2}$ by $18\frac{3}{8}$ plywood.

If the cabinet is to be enameled white, which is usually the preferred finish, an excellent wood to use is whitewood, but any other soft wood that can be obtained easily and reasonably, such as white pine or cypress, will serve.

A complete bill of materials giving the exact sizes of the pieces needed in making the table, and full working details are contained in Home Workshop Blueprint No. 27, which will be sent to any reader for 25 cents.

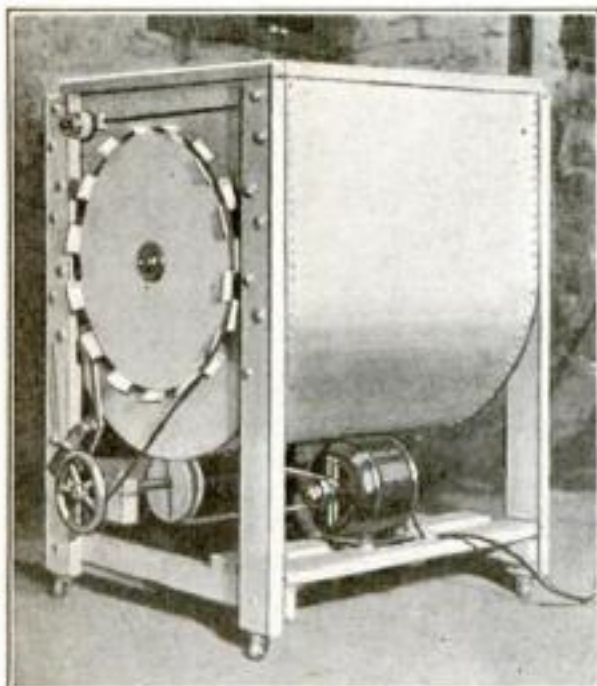
Are You Taking Advantage of Our Workshop Blueprints?

MANY of our readers are spending pleasant and profitable hours of their spare time in making articles described in the Home Workshop Department and detailed in our series of blueprints. A letter from one of them, Charles L. Hausel, of Marcus Hook, Pa., is as follows:

Inclosed find photograph of the electric washing machine I constructed from your Blueprint No. 12. The metal is copper, screwed to the cypress. The bearings are pieces of iron pipe filled with Babbitt metal.

I made the 6-in. pulley on the countershaft of 1-in. wood, and the 3-in. pulley is one from a sewing machine, as I could not get any grooved pulleys. Every one is very well pleased with the results.

This is a typical letter, and articles by the thousand made from our Home Workshop Blueprints are being used everywhere.



For each photograph considered worthy of publication showing an article made from Home Workshop blueprints, like this washing machine built by Mr. Hausel, POPULAR SCIENCE MONTHLY will pay \$2. Send prints to the Home Workshop Department, Popular Science Monthly, 225 West 39th St., New York.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

Blueprint Service Dept.

Popular Science Monthly
225 West 39th St., New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have checked below, for which I inclose.....cents in stamps or coin:

No.	Title	Price
1.	Sewing Table.....	25c
2.	Smoking Cabinet.....	25c
3.	Book Trough End Table.....	25c
5.	Kitchen Cabinet.....	25c
6.	V. T. Radio Receiving Set.....	25c
8.	Shaving Cabinet.....	25c
9.	Arbor with Gate and Seats.....	25c
10.	Porch Swing.....	25c
11.	Bench and Tilt-Top Table.....	25c
12.	Electric Washing Machine.....	25c
13.	Tea Wagon.....	25c
14.	Toy Train, Horse, and House.....	25c
15.	Home Workshop Bench.....	25c
16.	Inlaid Radio Cabinet.....	25c
17.	Cedar and Mahogany Chest.....	25c
18.	Telephone Table and Stool.....	25c
19.	Grandfather's Clock.....	25c
20.	Flat Top Desk.....	25c
21.	Colonial Writing Desk.....	25c
22.	Girl's Cabinet and Desk.....	25c
23.	Pergola Garage.....	25c
24.	Gateleg Table.....	25c
25.	Sailing Outfit for Canoe.....	25c
26.	Baby's Crib and Play Pen.....	25c
27.	Kitchen Cabinet Work Table.....	25c

Name.....
(Please print)

Street.....

City and State.....



Every Student Needs One Remington Portable

Keyboard just like the big machine



THE compact, convenient and complete Portable Typewriter. Sold by over 3,000 dealers and Remington branches everywhere. Easy payment terms if desired. Send for our illustrated "For You—For Everybody." Address Department 67

REMINGTON TYPEWRITER COMPANY
374 Broadway, New York Branches Everywhere

We believe we make the best typewriter ribbon
in the world—and its name is PARAGON

ATKINS

METAL CUTTING SAWS



Cut Faster, Easier —Do Not Break

PUT an Atkins Non-Breakable Blade in your hack saw frame, and you'll feel the difference at once. It will saw the toughest metal faster and easier than ordinary blades, hold its cutting edge longer, and will not break.

There's a reason. These blades are made of selected steel, and are hardened and tempered by an exclusive gas-and-oil process, which gives a hard, keen cutting edge and a tough, flexible body to the blade.

You can eliminate losses of time and money due to breakage of brittle blades by using Atkins Non-Breakable Hack Saw Blades. Prove it for yourself. Send ten cents and tell us what metal you want to cut, and we'll send you a sample 8 or 10 inch blade that will out-cut and out-last any other blade.

Saws for Every Use

When you need a hand saw, circular saw, band saw, pruning saw, metal-cutting machine, or any saw for cutting wood or metal—there's an Atkins product that will save time, money and labor. Write for our free booklet on the saws you require.



FREE Book On Saws

This book is full of helpful shop hints, and tables. Worth dollars to every saw user and buyer. It shows the right saw for every purpose and contains suggestions that will save you time, energy and money. Write us for your copy, NOW.

E. C. ATKINS & CO., Inc.,
Dept. D-20, INDIANAPOLIS, IND.
Makers of Silver Steel Saws and Tools



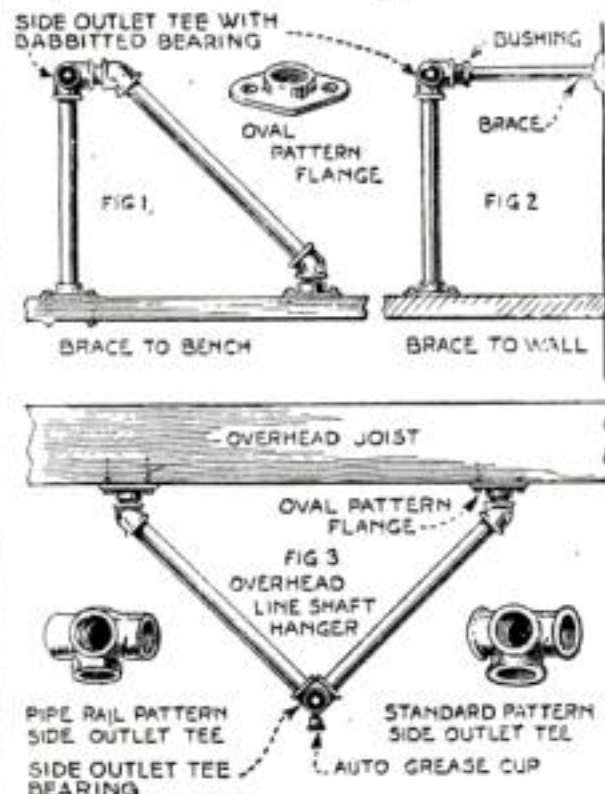
How to Make Rigid Shaft Hangers from Pipe Fittings

By John G. Hanna

MOST mechanics know that an excellent light shaft support or hanger can be made with a piece of pipe, a flange and a babbitted tee. In using such a support for carrying a countershaft some distance above my bench to operate a bench drill, I found that the belt could not be tightened very much and that there was a tendency toward vibration. The pipe, screwed tight, was rigid, but its length in combination with the small area of the base, gave it tremendous leverage on the more or less elastic wooden bench top.

The solution of this difficulty, I found, lies in the use of a side outlet tee in place of the ordinary tee. The additional outlet makes it possible to brace the hanger or support in one of the ways illustrated.

This fitting is not usually needed in the simpler kinds of plumbing and so is not



Three types of serviceable shaft bearings made with side outlet pipe tees

always obtainable in small towns. In that case it is well worth the few cents postage required to order it from the nearest large city. The side outlet tee, commonly called "s.o. tee" for short, is, like most pipe fittings, made in two patterns, the standard for conveying fluids, and the pipe rail pattern for making up railings and fences. Either will serve well for a bearing, although the rail pattern makes a neater looking job.

For the countershaft support on my bench, I used the arrangement illustrated in Fig. 1, with 45-degree ells, close nipples, and suitable lengths of pipe, as well as the side outlet tees. It is not often possible to so cut and thread your pipe that the brace leg will meet the bench exactly when the main support is plumb. This is easily adjusted, however, by screwing the base to the nearest turn a little short of meeting and putting shims under the brace flange. With shears, the shims can be cut from tin, sheet iron, or 1/32-in. sheet lead.

If you measure your layout very carefully and don't cut the threads too loose, you can obtain a good line-up by screwing one flange on and the other off a trifle, even without shims. All braces are adjusted and screwed down permanently before the shaft is put in and the pipe bearings are poured.

The arrangement shown in Fig. 2 is
(Continued on page 95)

Great NEW Invention

for seekers of

Health Power Beauty



Elco Health Generators at last are ready for you! If you want more health—greater power to enjoy the pleasures and delights about you, or if more beauty is your desire—write! Ask for the book on these inventions which has just been prepared. It will be sent to you without cost. It tells you how Elco Health Generators aid you in leaving the lethargy and hopelessness of bad health and weakness behind forever. Re-vitalize yourself. Bring back energy. Be wholly alive. Write today!

10 Days FREE Trial.
Write for FREE Book.



These great new inventions generate Violet Ray, Vibration, Electricity and Ozone—combined or separate.

They operate on the electric light in your home or on their own motive power at less than 50 cents per year. Elco Health Generators are positively the only instruments which can give you in one outfit Electricity, Violet Ray—Vibration and Ozone—the four greatest curative agents. Send the coupon below. Get the Free Book NOW.

Free Trial



For All These:

Rheumatism
Sore Throat
Asthma
Black Heads
Catarrh
Insomnia
Paralysis
Pimples
Falling Hair
Headache
Lumbago
Nervousness
Skin Diseases
Hay Fever
Neuralgia
Deafness
Pain
Development
Neuritis
Obesity

Mail Coupon for Free Book

Health
Power
Beauty

Do not put this paper down without sending the coupon. Don't go on as you are with pains and with almost no life and energy. You owe it to yourself to be a better man or woman. You were put here to enjoy life—not just to drag through it. So do not rest another day until you have put your name on the coupon here. That will bring the whole story of these great new inventions. Do it today—now.

Lindstrom & Company

442-448 N. Wells St., Dept. 13-67, Chicago

Please send me your free book, "Health—Power—Beauty," and full information of your 10-day Free Trial Offer.

Name.....

Address.....

How to Make Shaft Hangers

(Continued from page 94)

simpler if your bench is built against and fastened securely to a wall. A bushing in the side outlet allows the use of smaller pipe for the brace.

The same useful side outlet tees serve in another way to make the excellent overhead hanger shown in Fig. 3. As has been pointed out in this magazine before, overhead shafting should not be used in a basement shop, because it will vibrate the floor above, but in a regular shop, garage, or barn it has the advantage of not wasting any bench or wall space.

For the home workshop, lubrication can be supplied very easily by means of a small automobile grease cup screwed into a hole in the bottom of the bearing. Grease is not, of course, a satisfactory lubricant for a high speed shaft or for any shaft unless attended to at regular intervals.

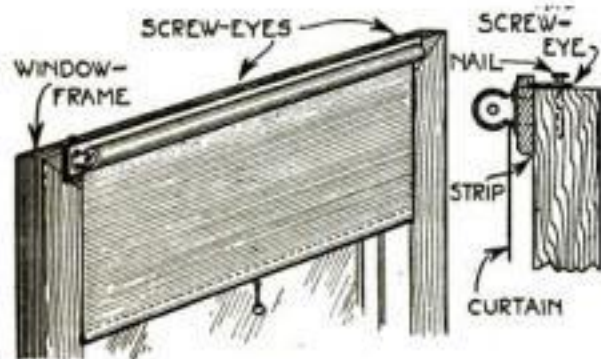
For mounting an overhead hanger on the usual 2-in. thick joist, oval pattern flanges are more satisfactory than the round type. This is another pipe fitting sometimes not to be had in a small store, but readily obtainable in large cities. It is well to ream the holes a trifle and use square head coach or lag screws instead of the slotted head screws for which the fitting is drilled and countersunk. For bench standards the common round flange is better, and through bolts and nuts are to be preferred to wood screws.

Attachment for Holding the Window-Shade Rollers

WINDOW shades may sometimes be used more satisfactorily if hung to the window-casings as shown below instead of in the usual fashion.

The shade and its brackets are mounted upon a light strip of wood or molding strip to match the style of window-casing.

Three screweyes are placed in the back of the roller support strip to hang it to



An auxiliary strip supports the roller brackets

the top of the window-frame over three small screws or nails placed in proper position.

This allows rollers to be used on window-frames that may not be exactly suited to the length of the roller, or do not permit the brackets to be placed in the requisite positions. The woodwork is not damaged or marred by the brackets and the shades are easily removed for cleaning or changing.

When installing the screweyes and nails, be sure to make all uniform so that the strips may be interchangeable for all of the windows.—B. F. DASHIELL.

Two varnishes of different kinds should never be mixed together because they will produce a new varnish that requires aging before use.



Miracle Men of Science

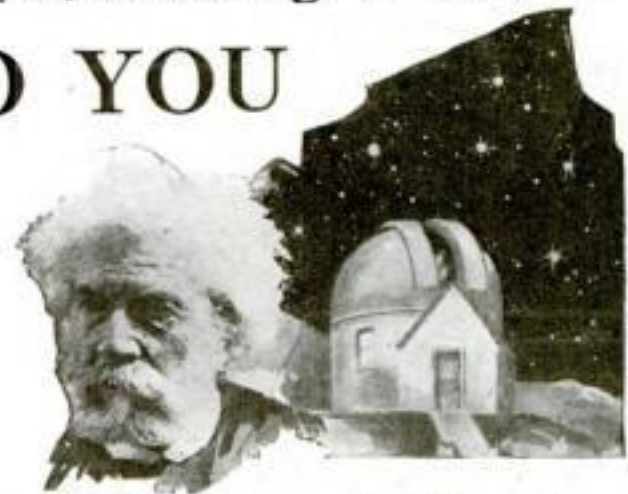
Their Amazing Achievements Told At Last In One Absorbing Story

FOR centuries men of genius have been making wonderful discoveries, have been disclosing the amazing secrets of nature, have been getting her great forces under control. Their achievements have changed our world and transformed our daily lives. The record of their triumphs forms a thrilling romance—a romance which has now been told, for the first time, in one simple flowing story. So that you may know about

this epoch-making work we offer

A Striking Booklet With Over 30 Fascinating Pictures FREE TO YOU

This profusely illustrated little book, with three color plates and over thirty black and white illustrations of scientific marvels shows how the four magnificent volumes of *The Outline of Science* describe the whole wonder world of science. This fascinating booklet is yours free—send the coupon below—no obligation and no expense.



The Romance of a Thousand Thrills

is *The Outline of Science* and this free booklet, with its amazing illustrations and interesting story, will show you how it tells of all the miracles science has accomplished since the beginning of time—how man has torn the veil from the distant past—how he has read the secrets of the heavens and the deep sea—how he has created instruments that give him unbelievable powers—how he has solved the riddle of life itself. "Should be read by every human being" says William Beebe, famous scientist. "More interesting to read than any romance."—N. Y. Globe.

Send Now for Your Copy of This Free Booklet



and see why hundreds of authorities are unanimous in praising *The Outline of Science*. The many illustrations in the booklet, taken from *The Outline of Science*, are of unusual value in themselves. And you want to know more about the great work which has been hailed as the most important publishing achievement in many years. Send the coupon now.

G. P. PUTNAM'S SONS, Publishers
Dept. 135, 2 West 45th Street, New York

Send This Coupon

G. P. PUTNAM'S SONS
Dept. 135, 2 West 45th St., New York

Send me by mail, without cost or obligation of any kind on my part, the free booklet with three color plates and over thirty black-and-white illustrations describing *The Outline of Science*.

Name

Street and No.

City and State

Occupation

THE wonderful photographic
Illustrations in Popular
Science are made possible only
by use of such lenses as

Bausch & Lomb TESSAR PHOTO LENSES

Ask your dealer for booklet, "What Lens
Shall I Buy?"—or write to us.



Bausch & Lomb Optical Co.
Rochester, N. Y.

New York Washington Chicago San Francisco London

POSITION GUARANTEED

**I
Want
You**

The Finger Print profession wants men immediately. Big pay, interesting work, no lay-offs or shut-downs. I will teach you quickly to become a trained Finger Print expert. I guarantee a position and back it up with a \$1,000 bank deposit. Write at once for full explanation and details about my free Secret Service course, free Secret Service reports and special low price. Offer is limited. Write at once. No obligation.
U. S. SCHOOL OF FINGER PRINTS,
Dept. 13-67, 7003 N. Clark St. Chicago

FREE



MAKE BIG MONEY

taking orders for Nationally known, hand-tailored **ARMSTRONG CAPS**. Exclusive designs, wonderful values, every cap guaranteed absolutely satisfactory. Let us show you how you can build a business of your own—make big money right from the start. Write today.

ARMSTRONG CAP CO.
327 Marion Bldg., Cleveland, O.



DO YOU LIKE TO DRAW? CARTOONISTS TRAINED BY W. L. EVANS MAKE MONEY

Some of the cleverest cartoonists are former students. They had no experience before enrolling, but worked at the lessons during their spare time and found **CARTOONIST EVANS' METHOD "easy to learn"** and are now making good money. It is not hard to learn to draw originals when shown in a practical way.

The School is recommended by well known cartoonists because they know the students are handled right.

If you like to draw and want to be able to sell your drawings, send a sample of your work (either a copy or an original) and let us see what you can do. We will send you the portfolio of cartoons and full details about the school.

The Course is **NOT EXPENSIVE**



**THE W. L. EVANS SCHOOL
OF CARTOONING**

825 Leader Bldg., CLEVELAND, OHIO

BE A HOTEL EXECUTIVE

EARN \$2,500 TO \$12,000 A YEAR

Fine Position—Little Experience

ONE student, a clerk in a small hotel, was dissatisfied with salary and opportunities. Now he is chief room clerk in a big hotel, earns a much larger salary and his opportunities for advancement are very bright. He writes: "This is to inform you of the new place I have obtained with the — Hotel as room clerk. The course has helped me wonderfully in securing this position. . . . I know my brief hotel experience would never have gotten me the position so soon."



Many Opportunities Like These

No Previous Experience Necessary

You can easily secure one of many fine hotel positions. 80,000 trained employees, men and women, needed this year. A few weeks of your spare time will train you thoroughly if you enroll for the Hotel Operation and Management Course. We will help you secure a position in the most fascinating business in America. More of our graduates are wanted than we can supply.

Send coupon today
**Standard Business
Training Institute**
Carlton Court,
BUFFALO, N. Y.



**Standard Business
Training Institute**
Carlton Court, Buffalo, N. Y.
Send me Free Booklet H-167.

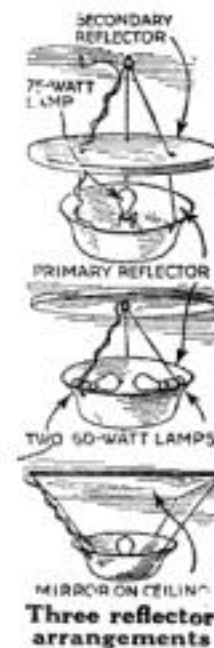
Name.....
Street.....
City..... State.....

Cheaply Made Garage Lighting Fixture Banishes Shadows

BY USING two inexpensive homemade reflectors, you can light your garage or shop with a mellow, diffused light that is much better for working purposes than the harsh light thrown by a single reflector.

The primary reflector is simply a 10-cent pan or basin. In the center of the bottom, inside, is fastened a porcelain socket with small machine screws and nuts. The inside of the bowl is then painted with two coats of white enamel or with aluminum paint. The aluminum reflects well but diffuses more than the enamel.

The secondary reflector may be made of wood and should be at least twice the diameter of the bowl. This is covered with tin or painted like the bowl. At a point equidistant from its center and slightly less than the radius of the bowl from the center, bore three holes. These should be only a trifle larger than the diameter of the wire to be used in hanging the bowl, and should pass squarely through at right angles to the face of the reflector. Solder three pieces of picture wire to the bowl, as shown, and run the



wire through the holes in the secondary reflector, fastening them to strong screw-eyes. It will then be found that the secondary reflector may be moved up or down if the bowl is lifted a trifle to release the tension on the wire. It is, therefore, possible to adjust the secondary reflector at the point where it is most effective.

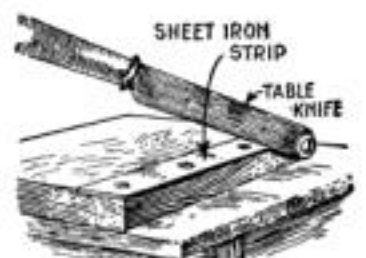
When the ceiling is too low to allow a secondary reflector, paint a circle with white enamel on the ceiling directly above the bowl. If the bowl is 15 in. in diameter, this circle should be about 4 ft. 6 in. An even better method is to mount an old mirror on the ceiling directly above the bowl, or suspend a mirror over the bowl, using four wires instead of three as in the case of the wooden secondary reflector.

The secondary reflector should be approximately 15 in. above the rim of the bowl, or the same distance above the bowl as the diameter of the bowl, in case a larger one is used. The best shape for a bowl is that of an ordinary hand basin.

When more light is needed than that given by a 75-watt nitrogen bulb, use two regular 60-watt lamps.—M. E.

Table Knife Quickly Converted into Photo Trimmer

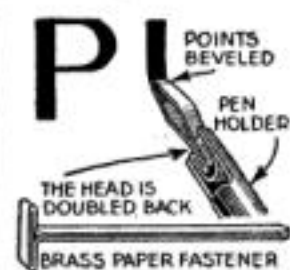
A WASHINGTON, D. C., schoolboy who wished to trim a number of small photographic prints, improvised the paper trimmer illustrated. The blade is a cheap steel table knife, one edge being ground to a sharp bevel. The knife is attached to a block of wood with a round head screw and washer and a strip of sheet iron is fastened to the right-hand edge of the base. The surface can be laid off with guide lines for measuring—G. L.



For cutting paper

Brass Paper Fastener Serves as Heavy Lettering Pen

A DRAFTSMAN who does high-grade shaded lettering on certificates, testimonials, and showcards, rarely uses anything but pens made of brass paper fasteners for heavy lettering. The amateur draftsman will find this type of pen a useful makeshift when a commercial shading pen is not at hand.

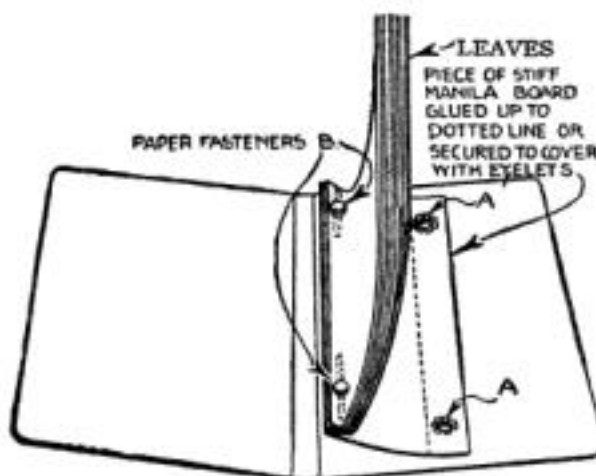


For "black letter" alphabets

A fastener should be chosen of a width corresponding to the width of the stems of the letters. The head is then doubled back to fit a penholder, from the center of which the split plug has been removed. The points are shortened, beveled back from the outside, and bent to form a reservoir for the ink. The edges are then filed to make them even.—C. M. T.

Speedy Method of Making a Loose-Leaf Notebook Cover

WHEN a loose-leaf notebook cover is needed quickly, or one of an odd size or shape is required, you can make it for a fraction of the cost of a commercial cover. The one illustrated, for a $4\frac{1}{4}$ by $7\frac{1}{4}$ in. sheet, is made of thin fiber board $7\frac{3}{4}$ by



An extra fiber strip inside the back cover holds the leaves

$9\frac{1}{2}$ in. Another fiber piece 2 by $6\frac{3}{4}$ in. is fastened with small metal eyelets, A, or paper fasteners to the cover, as shown. The loose leaves are then fastened to this strip with two or three paper fasteners, B.—A. E. STURDIVANT, Muncie, Ind.

When Grinding Wood Chisels

TO GRIND chisels and plane bits quickly and accurately I use a guide as shown. By holding the forefinger against the guide as a stop and running the tool to and fro sideways, never changing the grip when dipping the steel in water or examining the edge, I am sure to keep a true bevel.

A good many carpenters and cabinet makers, even after considerable experience, grind their tools "freehand" and therefore get several varieties of bevel before they obtain a good edge. An 8-in. length of $\frac{3}{8}$ -in. steel rod fixed about 1 in. above the arbor of the grinder makes a convenient guide.

—WALTER LYON, Plymouth, Wis.



The grip remains unchanged throughout



Learn to Play

You are always popular and sure of a good time if you can play some musical instrument. By yourself, with your friends around the piano, in orchestras or bands,—there is no end to the pleasure music will give you. And there is no easier way to earn money in your spare time.



Try It in Your Own Home

You may now have any known musical instrument for a week's free trial in your own home. There is no obligation to buy—no expense for the trial. You may return the instrument at the end of a week if you decide not to keep it.

Wurlitzer instruments are known everywhere for their unusual tone quality and excellence of workmanship. They are used by the greatest professional musicians, bands and orchestras. Harry L. Jacobs of Sousa's Band, Brooke's Marine Band, and Chicago Grand Opera says: "I am proud to be the owner of one of your new cornets. It is positively superior to anything I have had in all my years of cornet playing."

Thousands of amateur musicians are playing on Wurlitzer instruments. Many of them could not have bought except through the Wurlitzer selling plan.

Easy Payments

The Wurlitzer plan makes it easy for you to own the instrument you want. Payments are conveniently arranged in small monthly sums—a few cents a day will pay.

Wurlitzer is the world's greatest music house, with stores and dealers in all parts of the country. But no matter where you live you will receive the same service by mail as though you lived next door to the factory. Send the coupon today.

Send for Free Catalog

The greatest musical catalog ever published. Over 3,000 articles—every known instrument described and illustrated—many of them shown in full color. Gives you all details of the Wurlitzer plan. Send coupon now.

The Rudolph Wurlitzer Co., Dept. 1787

117 P. 4th St., Cincinnati 329 S. Wabash Ave., Chicago
120 W. 42nd St., New York 250 Stockton St., San Francisco

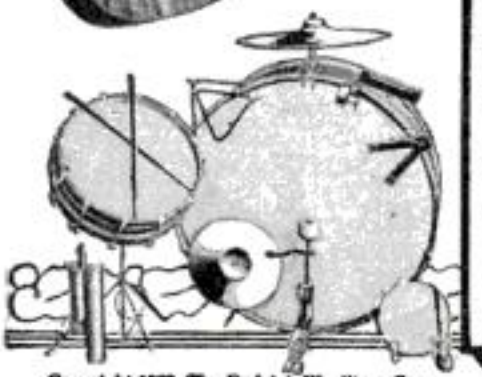
Send me absolutely free your new illustrated catalog of musical instruments. Also tell me how I may try any instrument in my own home at your expense and how the Wurlitzer plan makes it easy for me to buy. No obligation.

Name.....

Address.....

City.....State.....

Instrument.....
(State instrument in which you are interested)



Copyright 1922, The Rudolph Wurlitzer Co.



"What panel shall I use?"

ONE of the first questions you probably will ask yourself when you get ready to build your radio set will be about the choice of a good panel. Your answer will determine, to a large extent, the efficiency of your set.

Of course you want a panel that has superior insulating properties. Celoron Radio Panels are used by fans who appreciate the value of a good radio panel. They have high dielectric strength and great volume and surface resistivity. Celoron panels are uniform in quality, and do not warp or crack.

You will find Celoron panels easy to saw, drill, and tap. They engrave evenly without feathering, and enable you to build a set that is neat and attractive as well as efficient.

Approved by Uncle Sam

Celoron Radio Panels are approved by the U. S. Navy Department Bureau of Engineering and the U. S. Signal Corps. Many of the leading manufacturers of radio equipment use Celoron in their standard parts.

Each panel is wrapped separately in glassine paper and carries complete instructions for working and finishing. Ask your dealer for one of the following sizes:

1—6 x 7 x $\frac{1}{8}$	5—7 x 18 x $\frac{1}{8}$
2—7 x 9 x $\frac{1}{8}$	6—7 x 21 x $\frac{1}{8}$
3—7 x 12 x $\frac{1}{8}$	7—7 x 24 x $\frac{1}{8}$
4—7 x 14 x $\frac{1}{8}$	8—12 x 18 x $\frac{1}{8}$

We also furnish Celoron in full-sized sheets and can cut special sizes if desired. If your dealer has not yet stocked Celoron panels, ask him to order for you, or write direct to us. Indicate by number the size you want.

Send for free booklet

Our booklet, "Tuning in on a New World," contains a list of the leading broadcasting stations in the United States and Canada, several efficient radio hook-ups, and an explanation of the symbols used in radio diagrams. Write at once and be sure of getting yours before the supply is exhausted.

To radio dealers: Send for special dealer price list showing standard assortments

Diamond State Fibre Company

BRIDGEPORT (near Philadelphia) PENNSYLVANIA

BRANCH FACTORIES AND WAREHOUSES
BOSTON CHICAGO SAN FRANCISCO

Offices in Principal Cities

In Canada: Diamond State Fibre Company of Canada, Limited, 245 Carlaw Avenue, Toronto

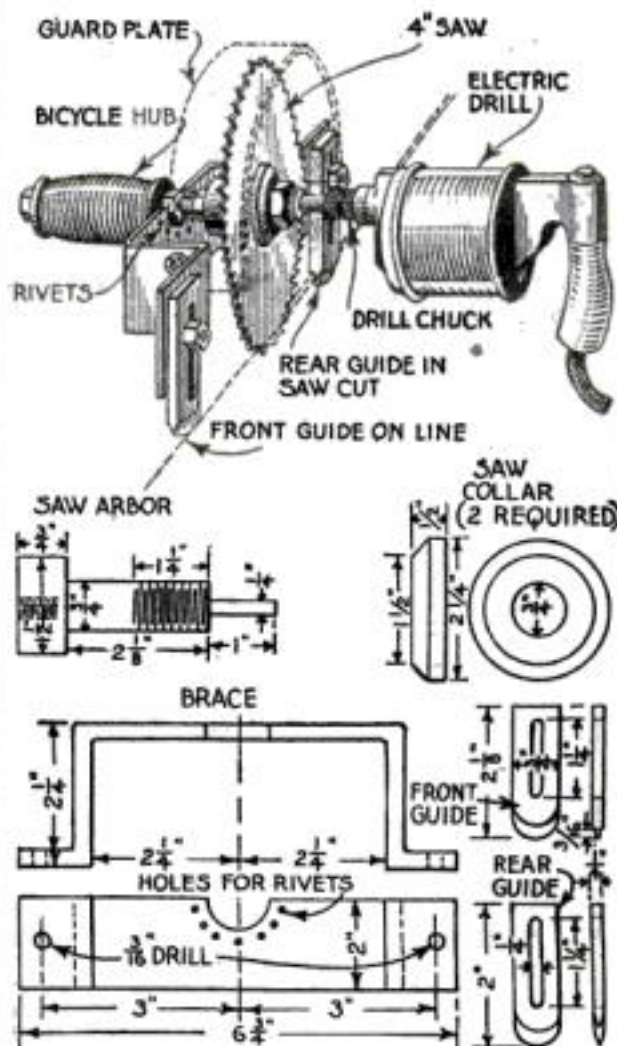
CONDENSITE
CELORON
STANDARD RADIO PANEL

Making a Grooving Attachment for an Electric Drill

By Arthur M. Samp

IF YOU are a worshiper at the home workshop shrine, you will do well to add an electric hand drill to your set of tools. One can be made, should the expense of a commercial drill not be warranted. Then, having a drill, add the saw attachment for grooving that is illustrated below. It will greatly increase the pleasure of woodworking, especially furniture and cabinetmaking.

The saw arbor is turned from a piece of cold rolled steel about $1\frac{1}{2}$ in. in diameter and 4 in. long. It is threaded with a left-hand thread and drilled and tapped to take the spindle of an ordinary bicycle hub. Two collars to hold the saw



Complete groover and details of the saw arbor, collars, brace, and guides

in place are purchased or made of mild steel.

A brace—of $\frac{1}{4}$ by 1 in. strap iron—for holding the guides is bent up and fastened to the face of the hub with small rivets. The front and rear guides are made of $\frac{1}{4}$ by $\frac{3}{4}$ in. strap iron and slotted with $\frac{1}{4}$ -in. slots. They are fastened to the brace by means of $\frac{3}{16}$ by $\frac{3}{4}$ in. stove bolts. The bicycle hub is wound with tape to form a suitable handle.

The guard is put on for safety, and it also serves to keep the sawdust from being thrown into the face of the operator. It is simply a piece of heavy sheet iron fastened to the brace.

The 4-in. cut-off saw can be purchased from any large hardware or woodworking machinery supply store, or even from one of the larger mail order houses.

To use the device for grooving, the small end of the arbor is placed in the drill chuck and the operator holds the drill in his right hand and the hub with his left. By means of the guides, the saw is made to follow the line. A scale of notches may be placed on the guides to make it possible to cut to a desired depth at the first attempt.

\$25.00 in PRIZES See top of page 4 in front of book for full details.

Prices Reduced On All Standard Make TYPEWRITERS



Lowest Prices in Years
We will ship any make you choose for one week's trial. Underwood, Royal, L. C. Smith, Remington, Oliver, etc.
Easy Terms Pay less than rent each month and own a typewriter. Guaranteed as good as new. Perfectly rebuilt by experts—the famous "Young Process." Send for our free trial offer and new low price list now. **WRITE TODAY.**

Young Typewriter Co.
World's Largest Dealers in Standard Typewriters
654 W. Randolph St., Dept. 142A, Chicago, Ill.

SEND NO MONEY 2 GENUINE DIAMONDS $\frac{4}{100}$ Each

Solid Gold
\$25

14 kt. White Gold
Top. Gold Emblem
Inlaid in Genuine

Hope Ruby

Can be had in all initials (Old English); also in all Lodge Emblems. Send size of finger and ring will be sent for inspection.

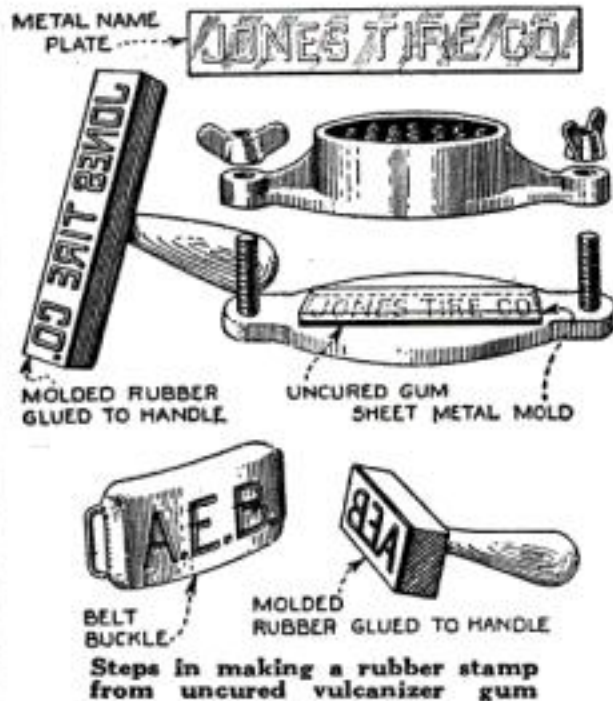


This Registered Trade Mark guarantees you genuine diamonds. Any Letter

Buffalo Jewelry Mfg. Co., "The Mail-Order House"
Dept. A, Brisbane Bldg., Buffalo, N. Y.

Rubber Stamps Can Be Made with Tube Vulcanizer

HOW easily a rubber stamp can be made with a small tube vulcanizer was demonstrated to me recently by a mechanic in a small tire shop. An aluminum strip with lettering such as is made by a stamping machine of the penny-in-the-slot type was used as a mold. It was coated with talc to prevent the rubber's sticking and covered with uncured vulcanizer gum. It was then clamped in the vulcanizer, which



was lighted for the same time that it takes to attach a patch. The resulting rubber stamp requires merely to be glued to a handle. If a strip of sponge rubber is placed between the stamp and the wood to serve as a cushion, however, the impressions will be clearer.

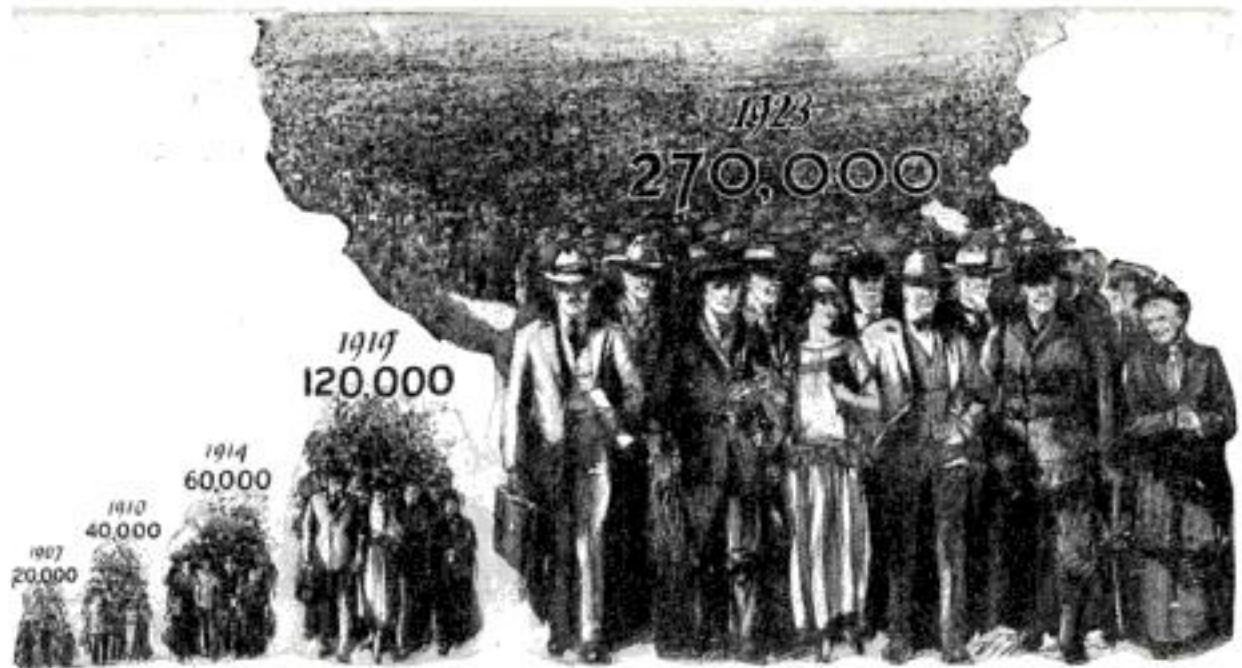
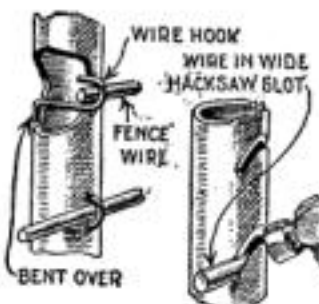
Monograms or other engraved lettering or designs may be used as molds, or a mold can be prepared for a facsimile signature stamp simply by etching or engraving the characters in metal. Punching thin metal with suitable stamps is another way of providing molds. Whenever a simple stamp is needed in a hurry, this is an excellent way to make it.—A. G.

How to Fasten Fence Wire to Iron Posts

DISCARDED iron pipes often can be utilized for fence posts if they are cut to length and given a coat of asphaltum paint to prevent them from further rusting. This would be done more frequently if simple methods for fastening wire to such posts were known.

One system consists merely of making a series of angular saw slots with a broad-cutting hacksaw blade. The wire is placed in this slot, stretched tight, and held by peening the slot shut.

In the other method, three holes are drilled where each strand crosses a pipe standard. Two of the holes are opposite each other and the third is immediately above one of them. A number of short pieces of wire are then bent around a block to the hook shape shown and used to clamp the fence wire.—J. V.



These groups of stockholders illustrate the rapid growth in ownership of the Bell System.

A Community of Owners Nation-wide

"Who owns the company?" "What is behind it?" These questions are asked in appraising the soundness of a business and in determining its aims.

The American Telephone and Telegraph Company is owned by more than 270,000 people living in every state in the Union. Could the stockholders of the Bell System be gathered to one place, they would equal the population of a city about the size of Providence or Denver.

They constitute a representative cross-section of American citizenship. Among them, of course, are bankers and men of large affairs; for the idea of

ownership in the Bell System appeals to sound business judgment and a trained sense of values.

In this community of owners are the average man and woman, the storekeeper, the clerk, the salesman, the professional man, the farmer and the housewife—users of the telephone who with their savings have purchased a share in its ownership. The average individual holding is but twenty-six shares.

No institution is more popularly owned than the Bell System, none has its shares distributed more widely. In the truest sense it is owned by those it serves.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service, and all directed toward Better Service



Save Your Tools and Save Money!

A place for every Tool and every Tool in a GERSTNER Case will save both money and Tools. A style, size and price to suit all trades. Catalog free.

H. Gerstner & Sons
345 Columbia St., Dayton, Ohio

COLD PIPE BENDERS

Standard of the World.
HAND and MOTOR OPERATED
14 Sizes of Machines
What it costs to bend pipe our way. Per hand.
1" pipe 5 cents 4" pipe 25 cents
2" pipe 10 cents 6" pipe 60 cents
3" pipe 15 cents 8" pipe \$1.00
Send for Catalogue.
AMERICAN PIPE BENDING MACHINE CO.
51 Pearl St. One year to pay. Boston, Mass.

Big 3-Ft. Telescope Useful and Entertaining (In Five Sections)

See people and objects miles away, on land or sea, as if they were close. Wonder Telescope gives new pleasures to home, farm, camp, travel, sport. See moon and stars as never before. Opens out over 3 feet long; measures 12 inches closed. Brass bound; has powerful lenses. Thousands pleased—"Could tell color of aeroplane 4 miles away."—Mrs. Yarbrough. "Saw Provincetown Light, 25 miles away, as clear as if in front of me."—Clyde Scribner.

SEND NO MONEY

SPECIAL OFFER!
while they last

"I have been watching submarines 3 miles off the coast."—P. Grush. "Can see children playing in school yard 6 miles away."—F. H. Hemmington. "Read the numbers on freight cars mile away, see mountains on moon."—A. G. Palmer.

Because of a fortunate purchase from a large European manufacturer we can give you a big bargain. Be first in your neighborhood; entertain your friends. Send no money; send only name and address for telescope complete by parcel post. On arrival deposit with Postman only \$1.85 plus a few pennies postage. Satisfaction guaranteed or money refunded. Order today while the supply lasts.

FERRY & CO., 75 W. Van Buren St. Dept. 1781 Chicago, Ill.



Only
10½ inches
long—
yet has
five
ratchet
adjust-
ments

In cramped places, where you can move crank only an inch either way, "Yankee" DOUBLE Ratchet keeps the bit cutting *continuously*.

"YANKEE"

Ratchet Hand Drill No. 1530

Weighs only 20 ounces. Slips into pocket. Yet has all five adjustments of big "Yankee" Drills. Finger-touch gives you: Plain Drill, Left-hand Ratchet, Right-hand Ratchet, DOUBLE Ratchet, or Gears Locked.

Dealers everywhere sell "YANKEE" Tools

Free Tool Book

Pictures and describes all the ingenious "YANKEE" Tools—Spiral Screw-drivers, Ratchet Hand Drills, Automatic Push Drills, and many others. Write for your copy today.



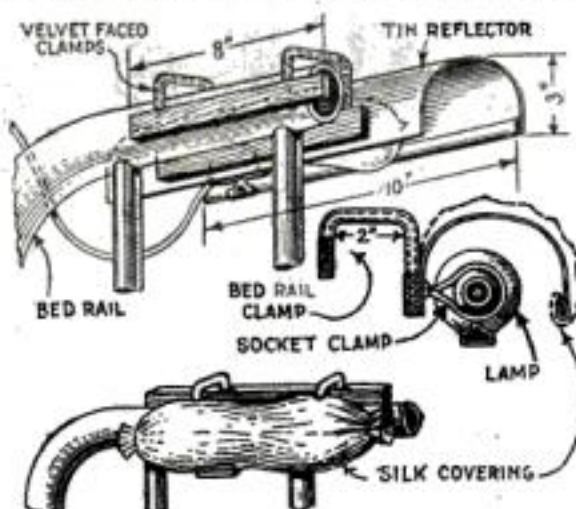
NORTH BROS. MFG. CO., Philadelphia, U. S. A.

"YANKEE"
TOOLS
Make Better Mechanics

Can Serves as a Reflector for Ornamental Bed Lamp

NEAT and inexpensive to make, the reading lamp illustrated is designed to hook on to the head of a bedstead. Its reflector is nothing more than a can about 5 in. in diameter and 10 in. long, cut lengthwise so that it will form a semi-circular roll about 3 in. deep.

Make two wooden cleats ½ by 1¼ by 8 in. and drill 2 holes edgewise through each to take a length of ⅛-in. steel wire. The wire, which should be in one piece about 22 in. long and covered with snug



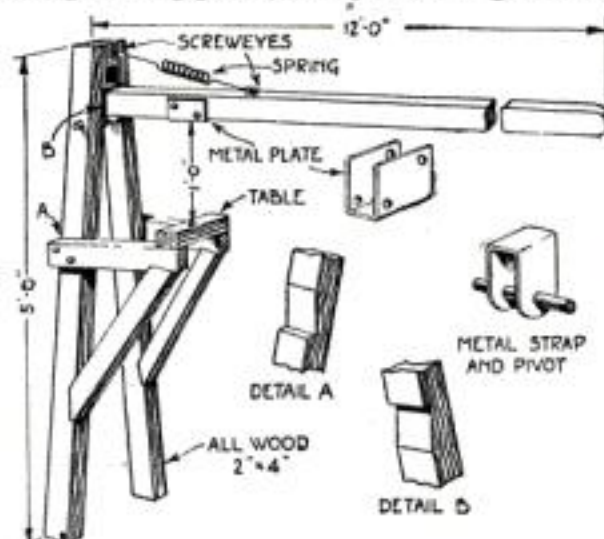
Scraps of tin, wire, wood, and silk form the parts of this serviceable night light

fitting rubber tubing, is bent into a U and slipped through the holes in the cleats. The ends of the wire are clinched to prevent the rear cleat from dropping off.

Next, bend the wire to form a clamp over the head of the bed, as shown. Cover the cleats with velvet to protect the finish of the bed. Fasten the reflector to the front cleat with screws and inside attach a wire loop 1¼ in. in diameter to hold the lamp socket. Solder ends to the reflector, and make a hole for the lamp-cord to pass through, being careful to roll the edge to prevent chafing the insulation. Cover the reflector with ruffled silk, fasten a socket in the wire loop, make the connection, and the light is ready for use.—EDWIN M. LOVE, Alhambra, Calif.

Light Press Built Cheaply from Two by Fours

BUILT mainly of 2 by 4 in. lumber, this cheap homemade press serves for putting in or removing bushings and gears, straightening parts, and performing similar



The 12-ft. lever gives power enough for all press operations usually encountered in the home workshop

work that requires considerable pressure.

By the use of suitable blocks, short pieces of pipe, and mandrels, almost any simple press work can be done with this press.—L. G.

Points a Finger at Any Shortcomings

Point at a workman's production-record, or a machine's rate-of-work:—you will make your point! The record will be improved if it *should* be.

Your presence at the machine isn't demanded. A Veeder Counter will represent you, and get the results *due* you.

In developing production (human or mechanical), what's required of the man and possible for the machine may be *had* with a

Veeder COUNTER

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, \$11.50—subject to discount. (Cut less than ½ size.) Set-Back Revolution Counter of similar model, \$10.00 (list).

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording

the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the

higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, \$2.00. (Cut nearly full size.) Small Revolution Counter, also \$2.00.

Everything you could ask in a counting device is shown in the 80-page Veeder booklet. Ask for this wonderfully complete counter book—free.

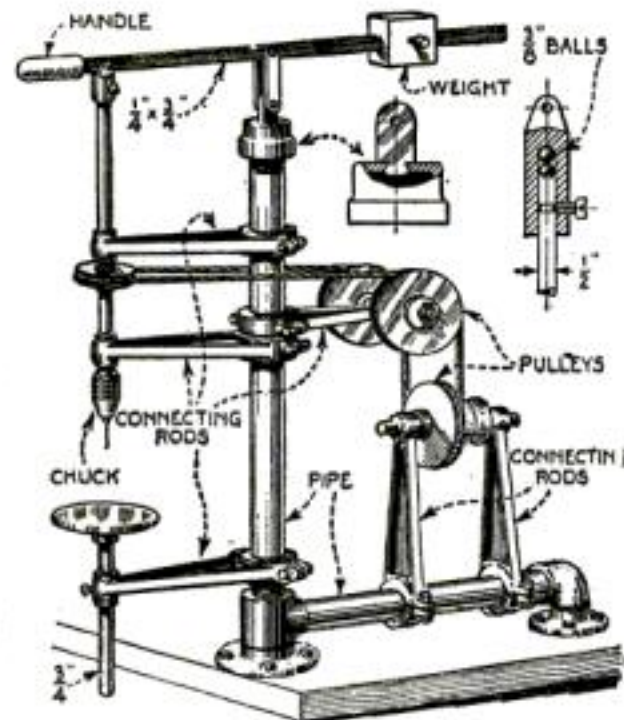
The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

Connecting Rods and Pipe Form Sensitive Bench Drill

BY UTILIZING connecting rods such as are used on Ford cars, the home worker can make himself a handy sensitive bench drill at little cost for material.

The parts needed are six connecting rods, some 1-in. pipe, one T, one ell, one cap, two close nipples, and two pipe flanges. The pulleys in the drill illustrated were taken from old oilers, but they can be cast from babbitt and turned up on a lathe or made in any other way that is convenient. The $\frac{1}{2}$ -in. shafts run in bronze bushings clamped in the ends of the connecting rods. The connecting rod that carries the idler pulley shaft must be heated and bent one quarter around at the small end.

The drill table is a fan pulley flange with a $\frac{3}{4}$ -in. shaft long enough to allow up and



The accuracy of this homemade bench drill is insured by the use of six light automobile connecting rods for the more important parts

down adjustment. A bolt in the end of the supporting connecting rod clamps the table at any height.

The hand feed rod and other parts are made as shown, from material found in the junk pile. A lead weight with a setscrew goes on the end of the feed lever to keep the drill up.

Light, quick, and sensitive, this drill will do as accurate work as the amateur mechanic and car owner usually requires.—GEORGE H. CAPPEL, Wilmer, Ala.

Saw Teeth Improve Wood Rack

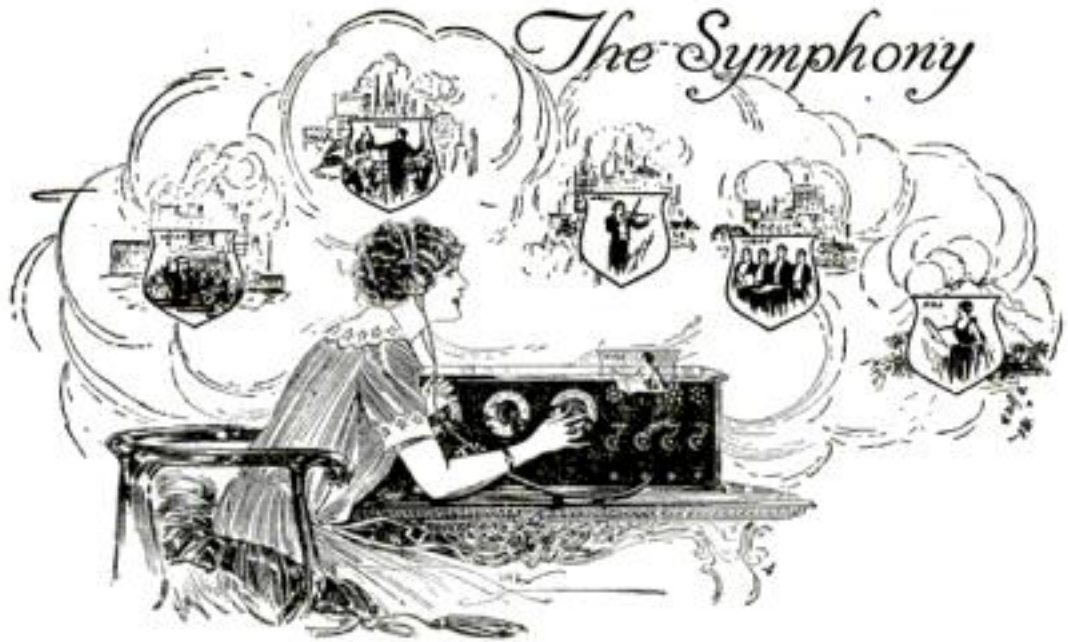
TO KEEP round firewood from turning in a wood rack or saw-buck, it is necessary only to nail to diagonally opposite arms of the rack 8- or 10-in.



sections of a broken or discarded crosscut saw. These are placed as shown, with the teeth projecting $\frac{1}{4}$ or $\frac{3}{8}$ in. In fact, one section usually is sufficient.

The old saw blade can be cut and punched while hot, as it is not necessary to preserve the temper of the teeth.

If children are accustomed to play around the woodpile, always leave a good sized pole of wood in the rack. This will serve to guard the projecting teeth and prevent accidents.—E. H. TAYLOR, Howell, Tenn.



THE ability to select your entertainment from the various programs that are being broadcast, and the clarity with which long distance stations can be heard depend entirely on the quality of the receiving set.

The Symphony is an unusually good receiver. By turning a single knob under proper conditions, it is possible to tune in stations, one by one, to the total exclusion of all others.

This improved circuit, in the vernacular of the technical expert, is an improvement over the single circuit by means of a variometer, and affords unusually selective reception.

So efficient is the Symphony that its volume, at any stage, surpasses many sets, and is equal to many

other receivers using additional stages of amplification.

Every piece of apparatus that goes into the Symphony is the best that can be produced, and each unit is correctly mounted in proper relation to each other part, factors that play an important part in your satisfaction of radio.

The placing of a Symphony in your home is a permanent investment that will win your instant approval, and occupy a prominent place among your most cherished possessions.

The Symphony Receivers are made in two types—detector, and two or three stages of audio frequency amplification.

If your dealer cannot furnish information on the Symphony, wire, or write for illustrated catalog, giving us his name.

JONES RADIO COMPANY

1066 W. Adams Street
Chicago, Illinois

The Symphony is manufactured under the U. S. Patent No. 1113149, Armstrong Regenerative Circuit. All parts used in the Symphony are built and guaranteed by the Kellogg Switchboard & Supply Company manufacturers for twenty-five years of complete telephone equipment.

Make Big Profits Charging Batteries

Small cash payment brings you HOBART 8 hour charging outfit. Easy to use of only \$50 monthly let your profits pay balance with nice surplus besides. Thirty day free trial on money back guarantee lets you try HOBART outfit at our risk. HOBART's patented voltage-regulating winding absolutely prevents reversing. Saves current. Start now to make big profits with HOBART 8 hour battery charger. Write today for information.

HOBART BROS. CO.
Box P10, Troy, Ohio



Learn to Mount Birds

Learn at home to mount birds, animals, game heads; taxidermy, make rugs and robes. Complete lessons. Easily and quickly learned by men, boys and women. Write for Free Taxidermy Book. Tells all about it. Every sportsman, trapper and Nature lover should know this wonderful fascinating art. Save your trophies. Big profits. Success guaranteed. 75,000 graduates. Investigate. Write for Free Book. Northwestern School of Taxidermy 1787 Elwood Bldg., Omaha, Neb.

1 1/2 H.P. \$43.45



Now, a more dependable, durable, powerful engine Direct from Factory at Low Price. 2 1/2, 3 1/2, 5 and 7 horse-power sizes also at a Big Saving.

EASIEST ENGINE TO START. 90 DAYS' TRIAL. 10-YEAR GUARANTEE; CASH or EASY TERMS. FREE BOOK—"How to Know Better Engines." Also Special Offer. Write today! OTTAWA MANUFACTURING CO., 1951Y King St., Ottawa, Kansas. Desk 1951Y Magee Bldg., Pittsburgh, Pa.

21 Jewel Burlington



Adjusted to the Second—Temperature—Isochronism—Positions—21 Ruby and Sapphire Jewels—Cased in a 25 year Gold Strata Case. Only \$1 down will bring you this masterpiece. Write today for free book to

Down Burlington Watch Company 19th St. & Marshall Blvd., Dept. 13-67 Chicago, Ill.

562 page RADIO BOOK only

Compiled by
HARRY F. DART, B.S.E.E.

Formerly with the
Western Electric Co.,
and U. S. Army
Instructor of Radio

Technically edited by
F. H. DOANE

\$1

Just off the press

THE greatest book on Radio ever written. Price only \$1. Filled with sound, practical, tested information for every radio fan, from beginner to hard-boiled owl. Written, compiled and edited by radio experts of national reputation.

Every page tells you something useful. And there are 562 pages! More than 150 illustrations and diagrams! Note this partial list of contents:

Different types of receiving and sending hook-ups, electrical terms, condensers, oscillating circuits, coupled circuits, induction coils, antenna systems, electric batteries, generators and motors, protective devices, crystal detectors, arc generators, transmitters, filters, wavemeters, radio experiments, International and Morse codes, commercial receiving sets, tables and data, radio transmitting and broadcasting stations (with call letters), Radio License Regulations, etc.

A pocket course in RADIO

You may dip into this I. C. S. Radio Handbook at random, or hunt up special information you want, or read it right through. It's interesting—fascinating—profitable! Hundreds of suggestions for helping you get more pleasure out of Radio. Will save you from wasting money on things that won't work. Money back if not satisfied.

Send \$1 to-day and get this 562-page I.C.S. Radio Handbook before you spend another cent on parts.

International
Correspondence
Schools
Box 7659-C
Scranton, Penna.

I enclose One Dollar. Please send me—post-paid—the 562-page I.C.S. Radio Handbook. It is understood that if I am not entirely satisfied I may return this book within five days and you will refund my money.

Name.....

Address.....

Mail the coupon TO-DAY

IT'S SO EASY \$15 A DAY To Agents



You can easily earn \$15.00 a day or more taking orders from your friends and neighbors for our fine tailoring. Orders come easy when you show our swell samples, smart styles and EXTREMELY LOW PRICES. We show you how—you can do it easy—You don't need any experience.

OUR SWELL TAILORING is worn by snappy dressers everywhere and big money is earned yearly by men who send us these orders. WHY NOT GET YOUR SHARE OF THESE FINE CASH PROFITS?

Save \$5.00 to \$10.00

We sell our tailoring at lowest wholesale prices to men who recommend and boost us to their friends. Get our FREE SAMPLES and pick your fine clothes at a saving of \$5.00 to \$10.00 on every suit.

FREE! Write today for big sample outfit. It will be sent FREE.

Washington Tailoring Co., Dept. W617, Chicago, Ill.

Constructing a Sawtable for the Home Workshop

By Henry S. Laraby

FOR the home or farm workshop where the necessary power is available, no single machine will do as much work and pay more returns in time and labor saved than a circular sawtable. The one illustrated has been so designed that it can be built at a minimum cost and with as little work as possible.

The complete mandrel with the bearings can be obtained from mail order houses or from machinery supply dealers for \$10 or

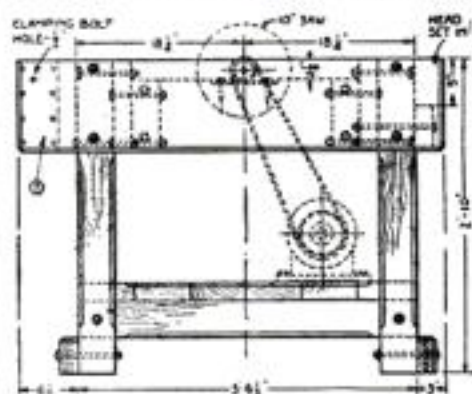
Ripping heavy stock on
the sawtable



less. A standard size is a mandrel 1 1/8 in. in diameter and 16 1/2 in. long, with a 2 1/2-in. flange, a 2 1/2-in. pulley with 3 1/2-in. face, weighing about 22 lbs. complete. This takes a saw with a 1-in. hole. It is ordinarily much cheaper to buy such a combination than to have a mandrel turned and the boxes made in a machine shop.

The help of a blacksmith may be required to bend the 3/8-in. thick tilting plates (No. 6), but even that can be done at home if sufficient heat is applied to the metal. While it is not important that the bend should be sharp, it is better to have the pieces true right angles. The wood may be left rough or planed at the mill, according to the degree of finish desired.

In putting together the top of the table, try each strip with a plane or otherwise to find the direction of the grain, and arrange



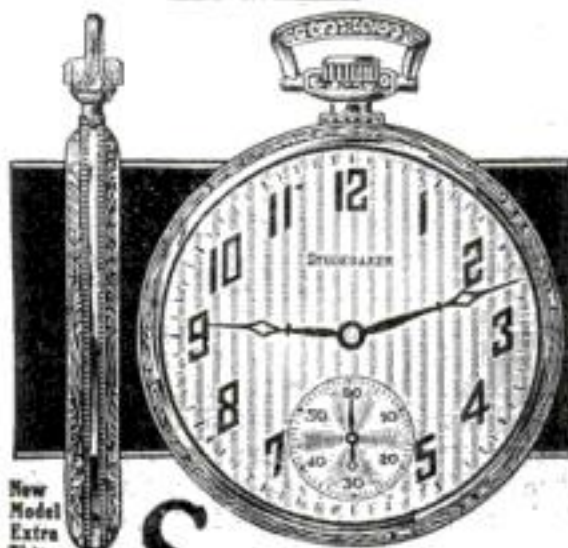
Front
and end
views of
the
saw-
table
frame

the strips so that the grain will run the same way, that is, from the working end toward the other end. This will aid in getting a perfectly smooth top and prevent it from roughening up when boards are pushed over it.

In constructing the top, the piece that corresponds in width to the ways running the length of the table should be 1/2 in. less in thickness than the other pieces, to allow for the thickness of the iron strips that form the ways. The grooves for the pair of crossways are made after the top is assembled.

The top is fastened with hinges to the frame, as shown, after the four tilting
(Continued on page 103)

21 Jewel ~ Extra thin STUDEBAKER The Insured Watch



New
Model
Extra
Thin

SENT FOR \$1.00 DOWN!

Only \$1.00! The balance in easy monthly payments. You get the famous Studebaker 21 Jewel Watch—Insured for a lifetime; a choice of 54 new Art Beauty Cases; 8 adjustments, including heat, cold, isochronism and 5 positions—direct from the maker at lowest prices ever named on equal quality.

Write today for FREE BOOK of Advance Watch Styles.

Gold Chain FREE!

For a limited time we are giving away FREE with every Studebaker Watch a beautiful pattern Studebaker Watch Chain. Write now while offer lasts.

Mail Coupon for FREE Book of Advance Watch Styles

Send at once and get a copy of this book—FREE! See the newest, beautiful, advance styles in Studebaker Art Beauty Cases and Dials. Read how you can buy a 21 Jewel Studebaker Insured Watch direct from the maker—save big money—and pay for it on easy monthly payments.

Write! for our free book. It will post you on watch styles and watch values. Send coupon at once. Get Free chain offer today while it lasts.

Studebaker Watch Co.
Dept. 2310, South Bend, Ind.

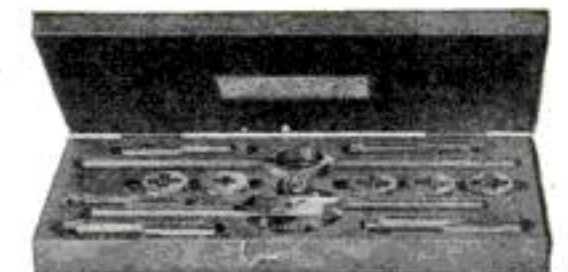


STUDEBAKER WATCH CO.
Dept. 2310, South Bend, Indiana
Please send me your Free Book of Advance Watch Styles and particulars of your \$1.00 down offer.

Name.....

Address.....

City.....State.....



Special 5 Size Tap and Die Set, Only \$3.00

DIRECT FROM THE FACTORY TO YOU!

Our No. 12 Automobile Set furnished in our highly finished chestnut box contains 5 each taps and dies (1-4, 5-16, 3-8, 7-16, and 1-2"), in the S. A. E. thread, 1 die stock, and one tap and reamer wrench.

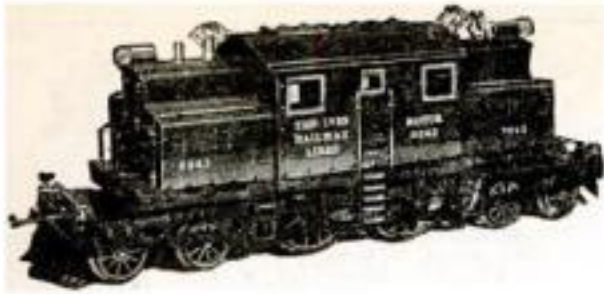
Our No. 11 Set is the same as No. 12 except that the thread is U. S. S. instead of S. A. E. You are purchasing a splendid set at a very low figure.

Send us your order at once and be one of our many satisfied customers. Let us also send you one of our circulars illustrating our full line of Handy Tools.

WORCESTER STEEL PRODUCTS CO.
Dept. T., 29 Union Street, Worcester, Mass., U. S. A.

\$25.00 in Prizes

See top of page four in front of book for details



Boys!

These are perfect working models

THINK of the fun of operating a complete Railroad System, all your own! One that is an actual reproduction, down to the littlest detail, of the most up-to-date railroads in the country.

Ives Railroads are perfect working models. There are powerful electric passenger engines, exact reproductions of the latest type used by the New York Central; husky freight locomotives like those on the big coast-to-coast lines. These engines reverse and have real headlights and you can control their speed accurately.

There are parlor-cars, coaches and observation cars with real lights inside them and automatic couplings. There are mail and baggage cars; box-cars, tank-cars, cattle-cars, gravel-cars. There are switches, semaphore signals, station-lights, crossing gates, etc. Everything, in fact, that there is in a big system. You don't know what fun is until you operate your own Ives Railroad.

If you're more interested in ships, start an Ives Fleet. There are great liners, freighters, tug-boats, submarines, destroyers, pleasure craft and racing yachts. All working models of the real thing. Run your own over-seas shipping company together with your railroad.

Send for this book

THERE is a beautifully illustrated book with 12 pages in full color that tells all about Ives Trains and Ives Boats. It shows you just why every boy wants the real thing, made by Ives.

Send 10c in coin or stamps with your name and address and you'll only have to wait a few days before the post-man brings you your copy of this great book.

THE IVES MANUFACTURING CORPORATION
203 Holland Ave., Bridgeport, Conn.



Ives Toys
MAKE HAPPY BOYS

Constructing a Sawtable

(Continued from page 102)

plates have been put in place. It should be noted that one right-hand plate and one left-hand plate No. 6, and one right- and left-hand plate No. 7 are required. By tilting the table, the depth of the saw cut is regulated.

The framework may be painted, shel-lacked, oiled, or varnished, except the table top, which is simply oiled. It is advisable to paint the inside of the top to exclude dampness as much as possible.

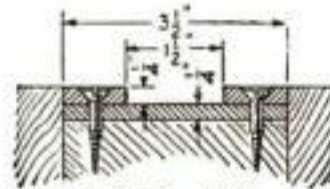
The detachable ripping fence permits making cuts at angles up to 45 degrees. Cross cut angles are obtained by adjusting the cross cut fence, and to facilitate angular work a scale of degrees may be laid out on the cross cut fence sector.

The list of materials for the sawtable is as follows:

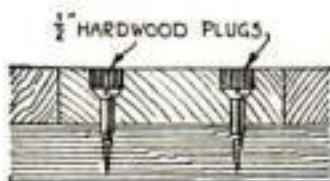
Table top, 2 by 35 by 47 in., maple or birch.

Top cleats, 2 by 4 by 30 in., oak, 2 required.

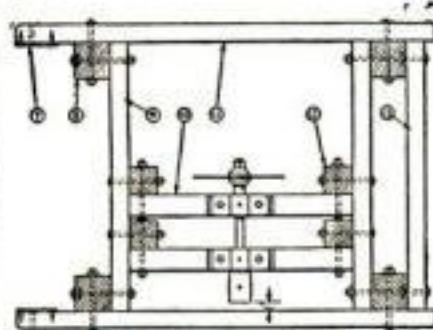
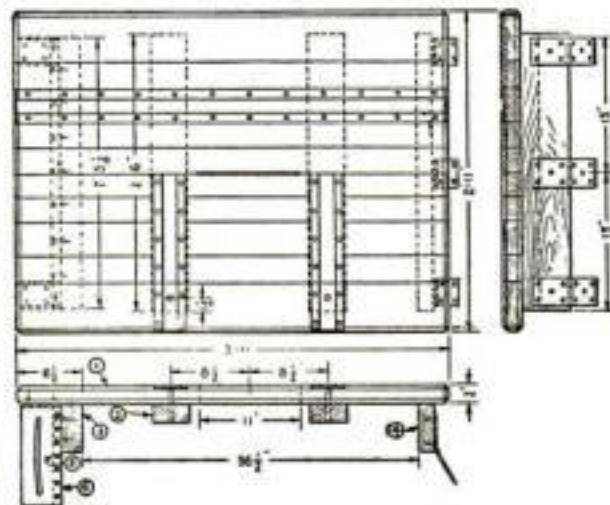
(Turn to page 104)



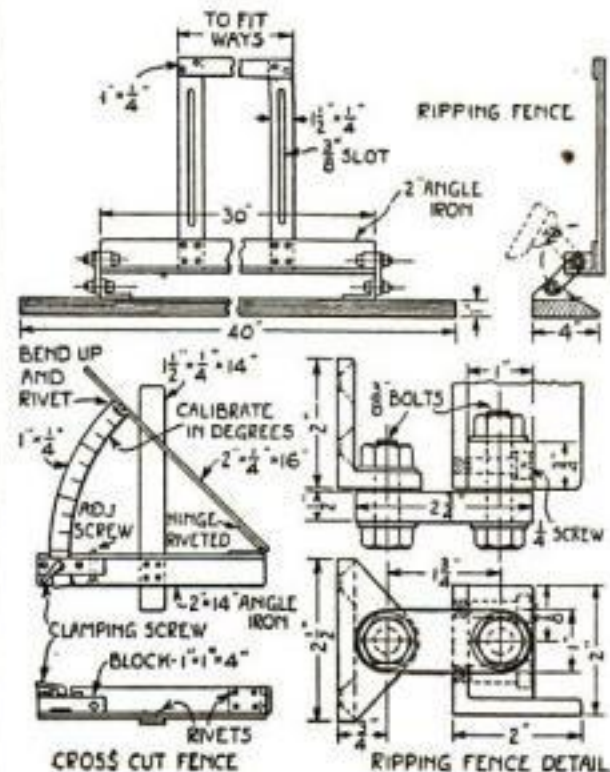
SLIDEWAY DETAIL



METHOD OF FASTENING TABLE TOP



Details of the table top (above), general plan of the frame (at left), and fence details (below)



2½ Tons Heats 5 Rooms!

"There is no heater to compare with the Bulldog. I burned 2½ tons of coal last winter and heated five rooms and bath."
—Walter Geary, Gloucester, Mass.

That's what the Bulldog does with coal! Here's what it does with about the lowest grade fuel you can think of!

"I can run my Bulldog furnace steady for fourteen days in normal weather conditions on the actual cost of fifty cents." So writes F. R. Redetzke, of Cleveland, North Dakota, and he adds: "Hard to believe, is it? That's what some of my neighbors thought until I showed them! We have an unlimited amount of grain screenings in this country. That's the fuel I am using."



\$10

Puts the Bulldog in Your Home

and then Only \$10 a Month!

If you are even thinking of a pipeless furnace, or any furnace, write for our free catalog. The Bulldog is one furnace you MUST investigate. Comes completely erected. You install it yourself! A really extraordinary development in heating. Factory connections in both East and West. We ship from nearest point. Don't consider buying any furnace until you find out about the Bulldog. Write now—before you forget!

Fits Any Floor Height

No matter what the depth of your basement or cellar may be—the Bulldog fits it. The adjustable casing (another common sense feature) takes care of this.

Write at once for our offer and our free catalog together with the wonderful record of Bulldog success. Mail this coupon Today.

Babson Bros.

19th and California Ave., Dept. 13-67, Chicago
Without obligating me in any way, please send me your free catalog and \$10 down offer on the Bulldog Pipeless Furnace.

Name.....

Address.....



The World's Most Popular Battery Charger

Nothing speaks so eloquently of HOMCHARGER satisfaction as the fact that thru sheer merit alone it has become the *standard* by which all other battery chargers are judged. Over 125,000 HOMCHARGERS already in use offer the most convincing proof that it is the most efficient, economical and fool-proof battery charger at any price.

A NEW TRADE-MARK FOR A TRIED AND PROVEN PRODUCT

Its phenomenal success has led to the introduction of many inferior and make-shift imitations. To insure our reputation and protect the buying public against substitution, the Radio De Luxe HOMCHARGER henceforth will be sold under a new Trade-Mark, viz.:



Retaining the same fundamentally correct operating principle and beautiful appearance of our Radio De Luxe model, it is a step nearer ultimate perfection through adoption of several construction refinements dictated by the policy of Progress.

HOMCHARGER'S 10 POINTS OF SUPERIORITY

1. **Simple**—Only one moving and wearing part, replaceable after thousands of hours use for \$1.00. Will last a lifetime.
2. **Efficient**—Uses less than one-half the current of any bulb or liquid type rectifier. Will charge any radio or automobile battery for a nickel.

3. **Quick**—Its high charging rate of 7 amperes eliminates long waiting for battery to become charged. Will charge any "A" or "B" battery over night, or three times as fast as a 2-ampere machine.
4. **Clean**—No expensive bulbs to break or acids to spill or replace. No acid fumes. Charges without muss, fuss or bother.
5. **Dependable**—Tungsten contacts insure continuous operation—prevent sticking and stopping.
6. **Fool-Proof**—Can be operated by anyone. Attach to lamp socket and connect battery either way, it will always charge. High-grade ammeter eliminates guess work.
7. **Safe**—No danger of shock or fire. Tested and approved by Fire Insurance Underwriters everywhere. Gives tapering charge—will not overheat or injure battery.
8. **Beautiful**—Mahogany and Gold Finish.
9. **Unqualifiedly Guaranteed.**
10. **Popularly Priced**—Retail at \$18.50 complete (\$22.00 Canada). No extras to buy. Sold by all dealers.

FREE BROADCASTING LIST. Send today for Free List of Broadcasting Stations, and Circular Describing the Gold Seal Homcharger.

DEALERS!

JOBBER!

GOLD SEAL HOMCHARGERS will outsell any other radio device this season. "GOLD SEAL Business Builders" illustrates many attractive sales helps and explains how we are prepared to co-operate with the Trade in making this a "HOMCHARGER Year." Send for your copy and Trade Discounts, TODAY.

Insist on the GOLD SEAL

It is your protection against substitution. When buying order by name and verify by the GOLD SEAL, which appears on the carton as well as the nameplate



THE AUTOMATIC ELECTRICAL DEVICES CO., 131 West Third St., Cincinnati, O.
Largest Manufacturers of Vibrating Rectifiers in the World

\$25.00 in PRIZES

See top of page 4 in front of book for details



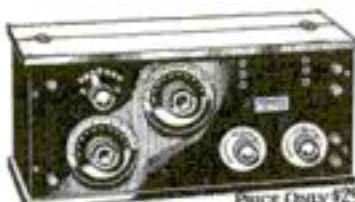
treat bruises

and possible breaks of the skin with the *antiseptic* liniment. Removes pains and reduces swellings—kills germs and prevents infection. Only a few drops required. Safest for children. \$1.25 at drug-gists or postpaid. Liberal trial bottle, postpaid, 10c.

W. F. YOUNG, Inc.

350 Lyman Street, Springfield, Mass.

Absorbine-J
THE ANTISEPTIC LINIMENT



PRICE ONLY \$29.50

At the low prices shown below you get the efficiency of sets costing three times as much. These radio frequency receivers pick up stations over 1,500 miles away under good conditions—everywhere.

Operate either on DRY CELLS or storage battery. Cabinets of solid mahogany and workmanship the finest throughout. Order direct or send for bulletin. Two tube outfit, as shown above, headphones only \$29.50

Four tube outfit for loudspeaker or headphones \$54.50

DEALERS—write for proposition quickly—it's a winner.

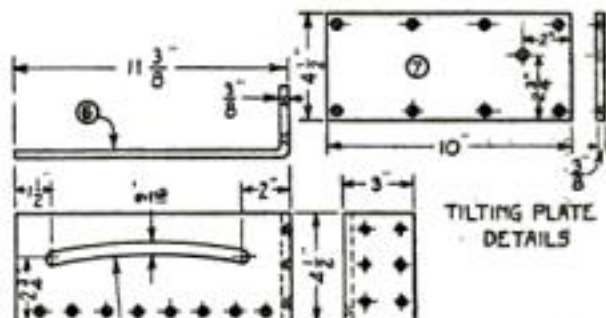
THE MIDWEST RADIO COMPANY
808 Main Street Cincinnati, Ohio



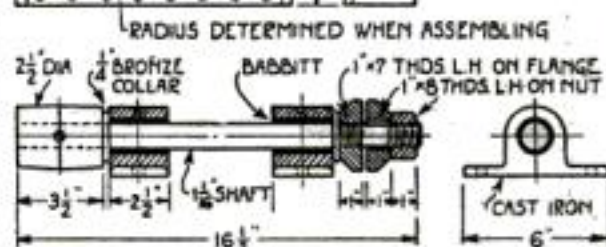
Constructing a Sawtable

(Continued from page 103)

- Top cleat, 2 by 5 by 29 1/4 in., oak.
Top cleat, 2 by 5 by 30 in., oak.
Plate brace, 1 by 11 by 28 1/2 in., oak.
Tilting plates, 3/4 by 4 1/2 by 14 1/2 in., iron, 2 required.
Tilting plates, 3/4 by 4 1/2 by 10 in., iron, 2 required.
Legs, 4 by 4 by 34 in., oak, 4 required.
Cross rails, 2 by 10 by 30 in., oak, 2 required.
Bearing beams, 3 by 7 1/4 by 24 in., oak, 2 required.
Table aprons, 2 by 10 by 46 in., oak, 2 required.
Tie pieces, 3 by 3 by 7 1/4 in., oak, 4 required.
Hinge cross rail, 2 by 5 by 30 in., oak.
Motor shelf, 2 by 22 by 36 1/2 in., oak.
Leg tie pieces, 2 by 4 by 36 1/2 in., oak, 2 required.
Lower cross rails, 2 by 4 by 30 in., oak, 2 required.



DETAILS OF
TILTING PLATE



Details of the tilting plate and the arbor.
The latter is standard and can be purchased cheaply

- Heavy hinges, 3 by 4 in., steel, 3 required.
Strips for slideways, 3/4 by 1 by 17 in., iron, 4 required.
Strips for slideways, 3/4 by 3 1/2 by 17 in., iron, 2 required.
Strips for slideways, 3/4 by 3 1/2 by 47 in., iron, 2 required.
Strip for slideways, 3/4 by 3 1/2 by 47 in., iron.
Bolts, 3/4 by 6 1/2 in., 16 required; 3/4 by 5 1/2 in., 6 required; 3/4 by 6 in., 18 required; 3/4 by 8 in., 2 required; 3/4 by 2 3/4 in., 2 required; 3/4 by 4 in., 2 required.
Lagscrews, 3/4 by 4 in., 2 required.
Screws, No. 14, 1 1/4 in., 1 gross; No. 14, 2 3/4 in., 1 1/2 gross.
Hardwood plugs, 3/4 in., 200 required.

Fence Materials

- Angle iron, 2 by 2 by 14 in.
Angle iron, 2 by 2 by 30 in.
Strip, 3/4 by 1 by 19 in., iron.
Strip, 3/4 by 1 1/2 by 14 in., iron.
Strip, 3/4 by 1 by 14 in., iron.
Strip, 3/4 by 2 by 16 in., iron.
Strip, 3/4 by 1 1/2 by 15 in., iron, 2 required.

A motor of 2 hp. is required for average work. If heavy cutting of hard woods is to be done, it would be better to use 3 hp. The switch should be placed in a position where it can be reached handily. It is well to have a locked or padlocked switchbox to prevent the saw's being operated by any one not skilled in its use, as the machine, like most woodworking machines, is dangerous unless properly handled. The utmost caution should be used at all times in operating it, as with a standard sawtable.

A countershaft can be used in place of the motor if the saw is to be driven by a belt from a gas engine, an auto wheel, a tractor, or other source of power. The pulleys should give a speed of at least 900 r.p.m., although theoretically the rim speed of a circular saw should be about 9000 ft. a minute, which means in the neighborhood of 2800 r.p.m. for a 10-in. saw. In other words, the high speeds are better if the power is sufficient.

Electric Iron Alarm

RECENTLY we found the house full of smoke caused by a red-hot electric iron that had been left on the ironing board. To prevent a similar accident, I placed a two-way socket at the end of the drop and screwed the iron plug in one and a red light in the other. The light reminds one to switch off the current.—G. M. V. H.

Still Time to Enter "The Most Useful of My Tools" Contest

IF YOU are reading this issue of POPULAR SCIENCE MONTHLY before September 20—it goes on the newsstands September 10—you still have time to enter the current tool contest and perhaps win one of the three prizes.

All mechanics and home workers do not agree on which is the most useful of their tools. Some prize most highly the saw, others the hammer, others the ax, the plane, the chisel, the file, the screwdriver, and soon. Mr. Romig put up an excellent argument last month for the steel tape line.

Now then—which is the most useful of *your* tools? Which one do you use most? Why? And how? Undoubtedly you have some uses for your tools that nobody else has thought of. Tell us about it in a letter of not more than 400 words.

We offer these prizes: \$25, first prize; \$15, second prize; \$5, third prize. The competition closes September 20. The winning letters will appear in the January issue.

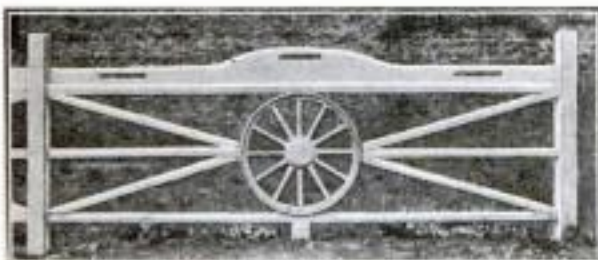
Each letter will be judged by the Board of Editors and their decision will be final. No letters will be returned unless accompanied by a self-addressed, stamped envelope.

Address, Tool Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York.

Auto Wheels Form Decorations for Fence Panels

AN UNUSUAL design for a fence can be obtained by using discarded auto wheels as decorations. Such a fence is especially appropriate around a filling station or on the grounds about a garage.

The construction is simple yet rigid. The top and bottom rails of each panel are



An ornamental fence for garages, and for general fencing purposes

2 by 2 in. and the wheel is held between them by the flanges of the iron rim. The fillers and braces are also 2 by 2 in. but the posts are 4 by 4 in. Good proportions are obtained by setting the posts 9 ft. apart. A 1-in. board cut in some simple pattern finishes off each panel neatly.

Paint the wheel some darker color, such as green and the rest of the fence white.—C. L. MELLER, South Fargo, N. D.

WHY NOT YOU?



Garage foreman at \$75⁰⁰ a week ~and in line for further promotion

Positions like this are waiting for men who can fill them. AND BIGGER JOBS AHEAD. Above the foreman, there is a better job as Service Manager. Every automobile dealer, every service station in every city in the country, needs one or more high grade foremen or superintendents. "Where can we get trained men?" they ask despairingly. They will willingly pay big money to you if you can fill one of these jobs. They want men who are not only good auto mechanics, but who know shop management,

modern repair methods, electric service, and who have a thorough understanding of the business as a whole.

You can get that knowledge in three months at the Michigan State Automobile School in Detroit, the Auto Center. Men in low paid, uninteresting trades, can fit themselves for better jobs now, or a business of their own. Miners, railroad men, street car men, furniture men, barbers, laborers of all kinds, are lifting themselves out of the rut, and establishing themselves, by taking M. S. A. S. training.

I Can Make You a Big Money Man Whether You Are Now a Mechanic or Not

Are you mechanically inclined? If so you can develop that aptitude and make a success in the automobile business. Not necessarily as a mechanic, but as a business man—with a foundation of mechanical training so that you "know how" and can direct the work of others. Our training will enable you to rise above the ranks to a position of responsibility. Successful men are not "born" they are "made." Foresight, planning, training, is what "makes" them.

Do you know that in one month of this year 404,000 new automobiles were built? Notice in every city, the automobile dealers have fine establishments. "Automobile Row" is the center of activity. The automobile dealer is the biggest man in this great business. Can you begin to imagine how great the need is for big men to lead the business of giving service to these cars? The opportunity is simply astounding. The industry has advanced so fast that enough trained men have not been developed to hold the big pay jobs.

I can fit you for one of these jobs, and even to run a business of your own, to have a service station or be an automobile dealer. Our graduates are doing it now all over the U. S. A., and in many other countries. I can start you to success, as I have thou-

sands of other men. This School and its courses are endorsed by automobile manufacturers and service men.

Write to me today for full information. I want you to have a good job. I can qualify you quickly. Write to me today.

A. G. ZELLER

Michigan State Automobile School
Box 590, 3729 Woodward Ave., Detroit, Michigan

-----Write a letter or use this coupon-----

A. G. Zeller, Michigan State Automobile School,
Box 590, 3729 Woodward Ave., Detroit, Michigan
Tell me how I can become a big money man. My present work is

Full Name.....
St. or R. F. D.....
City.....State.....
I am earning \$..... My age is.....

\$25.00 in PRIZES

See top of page 4 in front of book for full details.

This Wonderful Invention



converts any cook stove into a gas stove. Oxo-Gas made from kerosene and air is cheaper, cleaner and more efficient than coal. Send for catalog

illustrating Oxo-Gas appliances for all purposes where coal is used. We have openings for General Sales Managers and distributors. Only those who can finance themselves considered.

GLORIA LIGHT COMPANY
108 N. MAY ST. CHICAGO, ILL.

OIL EXPERTS in Demand

Good Positions Await Trained Men

The Petroleum Engineering field needs men, it needs them badly. With 10 million autos and thousands of new power plants a great shortage of lubrication engineers now exists—greater than ever before. Petroleum experts and lubrication engineers command big pay—\$250 to \$600 monthly. Thousands of National men are doing it—so can you. Learn at home in your spare time with the oldest and only school giving same instructions by correspondence as is given through resident school. (Certificate of Lubrication Engineering given).

BIG BOOK of Opportunities FREE

Send NOW for New Book, just out, "Opportunities in Petroleum Engineering." It is intensely interesting and instructive. It will show you many things you never knew about oil and lubrication problems. Also full particulars and special low fee awaiting those who ACT NOW!
National Engineering Schools
618 Manhattan Bldg., Chicago, Ill.



Science Says Use Nu-Gas To Cook and Heat

Up-to-date homes being built without coal bins because there's a better, cleaner, easier way to cook, bake and heat, by burning free air.

"Don't buy coal at present price," says a Domestic Science Expert. Don't buy it at any price. You can get far better results by burning free air and oil in the way science has recently discovered. The government does it; the big ships do it; factories do it; and new homes are being built without coal bins or wood-sheds because their owners have adopted the new, clean, dustless, dirtless, laborless device which fits in any stove.

Oil and Free Air Make Wonder Heat

Science has shown that one part of coal oil (kerosene) the cheapest of fuels, can be mixed with twenty parts of air (by a remarkable burner) and the result is a wonderful heating and cooking gas. Cheaper than city gas. No fires to build. Heats at twist of the wrist. Heats largest rooms in a few moments on coldest morning. Heats even for baking. No dirt, smell or soot. Saves work, saves furniture, saves health. And a new way has been found to cut useless parts, so that, of all burners, the NU-HEAT (the latest one) is the best and lower in price. Installed in a jiffy in your present range, heater, furnace—then you are no longer a slave to coal and wood and the expense, labor and

AGENTS

Make \$50 to \$200 a week. Full spare time. Personal co-operation. Write quick for exclusive territory and free sample case offer.

dirt they bring. Absolutely safe. Sent on 30 days free trial. Amazing ironclad guarantee. Free Book About Remarkable Way to Burn Air. Learn how to cut housework in half. Learn to save by having all the heat you want but only when you need it. Learn cheap way to have the warmest, cleanest, cosiest home in town. Just say "send Nu-Heat information free." Mention if you have heater, range or furnace. No obligation to you whatever.

A twist of the wrist on arising. Intense fire almost instantly

Wade Hill Manufacturing Co.
Dept. X41, St. Louis, Mo.

NEW TIRE
GUARANTEE/
30X3½ CORD 2.00
ACT NOW
WRITTEN GOLD BOND GUARANTEE WITH EACH TIRE

Greatest tire sale in America now on! Goodyear, Goodrich, Firestone, Fisk and other fine makes of tires going at record-breaking prices. These almost new tires will easily give thousands of miles of satisfactory service.

GUARANTEED 9 MONTHS

TIRE	NEW TIRE	TIRE	NEW TIRE
30x3	\$1.90	32x4½	\$3.75
30x3½	2.00	33x4½	3.75
32x3½	2.50	34x4½	4.00
31x4	2.75	35x4½	4.25
32x4	3.00	36x4½	4.25
33x4	3.25	35x5	4.25
34x4	3.50	37x5	4.25

Just send \$1.00 deposit for each tire ordered. Balance C. O. D. subject to inspection. Our written gold bond guarantee with each tire positively assures you nine months satisfactory service or another tire will be given at half price. Shipment made same day order is received. Order today—NOW.

INTERNATIONAL TIRE CORP.
80 EAST 14th STREET CHICAGO, ILLINOIS

Go-Joy
\$1.00 a Pair
HEADPHONE CUSHION
HUDSON-ROSS
123 WEST MADISON ST. CHICAGO

MOVIES In Your Home
Our marvelous practical Movie Machine's sell as low as \$5.00—and what's more, we have wonderful films at lowest prices—with a new film exchange service. Don't Miss This! Write NOW for Free Catalogue
PARAMOUNT MFG. COMPANY
Box 1371, Dept. P. S.
Boston, Mass., U. S. A.

Are You Reaching for the Truth?

I will tell you **FREE** Under which Zodiac Sign were you born? What are your opportunities in life, your future prospects, happiness in marriage, friends, enemies, success in all undertakings, and many other vital questions as indicated by ASTROLOGY, the most ancient and interesting science of history?

Were you born under a lucky star? I will tell you free, the most interesting astrological interpretation of the Zodiac Sign you were born under.

Simply send me the exact date of your birth in your own handwriting. To cover cost of this notice and postage, enclose ten cents in any form and your exact name and address. Your astrological interpretation will be written in plain language and sent to you securely sealed and postpaid. A great surprise awaits you!

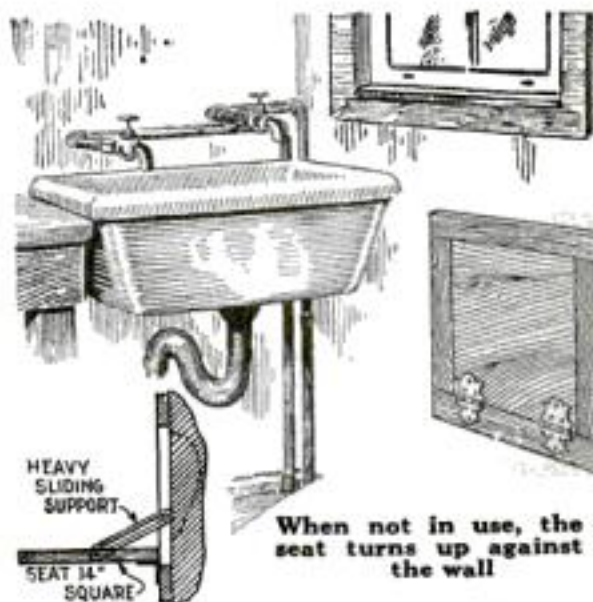
Do not fail to send Birthdate and to enclose 10c. Print name and address to avoid delay in mailing.

Write now—TODAY—to the
ASTA STUDIO
309 Fifth Ave., Dept. 137, New York

send birth date

Panel Seat Saves Steps in Small Kitchenette

IN SMALL kitchens or kitchenettes, where every foot of space is valuable, a panel seat made as illustrated is a useful addition. When not in use, the seat folds up flush against the wall. While it has nothing to recommend it in the way of



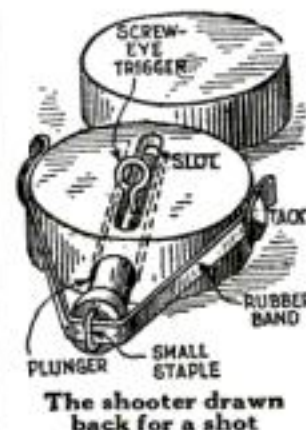
comfort, it does provide a handy rest for the housewife.

Chestnut or other hard wood 1 in. thick is used. The seat is fastened to the frame with two stout brass refrigerator hinges, and two very heavy sliding supports or stays hold the seat when down. A catch also can be added, although the seat illustrated remains up by tension and is opened by means of a small thumb notch in the upper member of the frame, not shown in the illustration.—A. G.

Carom Shooter Easily Made

THE simply made carom shooter illustrated is designed to save the fingertips. A checker or carom is drilled through horizontally to take a plunger made from a length of dowel or other small rod. A rubber band is tacked, as shown, and held against the enlarged end of the plunger by a staple.

In operation, the shooter is held in place with the thumb and second finger, and the index finger is used to pull back the screw-eye trigger.—G.E.H.

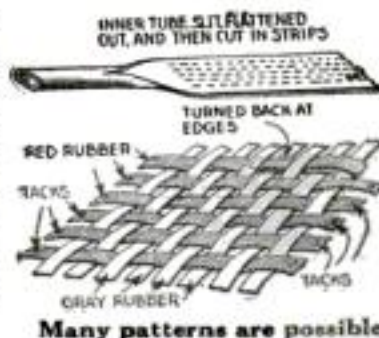


Weaving Small Rubber Mats

USEFUL rubber mats can be made quite easily from 1-in. wide strips cut from old inner tubes. If some of the strips are red and others gray, interesting patterns may be arranged.

First tack down the lengthwise strips, stretching them slightly, and then weave the cross pieces.

To fasten the ends, turn them in and weave back for about 6 in., pulling the ends snug and trimming neatly. Cementing the ends adds to the durability.—M. N. K.



1000 Things You Ought to Know

EVERY day in your work you get up against new problems—sometimes it is only some old "sticker" coming in a new way. Just the same though it takes a lot of time to figure it out. DON'T DO IT. Here's everything worked out for you. Every problem big or little that you will meet in a day's work. Hundreds of new ideas and better ways of doing things. Hundreds of ways the other fellows are making money. Hundreds of ways you can make more out of the same work you are doing now.

Cyclopedia of Carpentry and Contracting

Five great big volumes bound in genuine American Morocco with 2138 pages and more than 1000 blueprints, plans, pictures and diagrams. It is the newest, most complete, most practical work of its kind ever published. Twenty-five well known experts prepared these great books, gathering the material from hundreds of different sources. Every man in the shop and on the job should have them.

The old days of hit-or-miss experience are passed. You have got to know if you want to keep in the running now. A little of your spare time and the Cyclopedia of Carpentry and Contracting will put you way ahead of the rest. See our FREE trial offer and easy payment plan below.

What You Should Know About Architectural Drawing.
What You Should Know About Carpentry and Building.
How to Use the Steel Square Successfully.
How to Estimate the Cost of a Building.
How to Build a Frame or a Brick Structure.
How to be a Successful Building Superintendent.
What You Should Know About Contracts and Legal Relations.
How to Know Material and Select the Best.
How to Write and Read Building Specifications.
How to Read Blueprints and Plans.
1000 Better Ways of Doing Things.
How to Care for Tools.

FREE EXAMINATION 8 MONTHS TO PAY

Send coupon for these great Carpentry and Contracting books TODAY. You can't afford to be without them and you don't take any risk at all. The coupon brings the whole set by express collect for a week's free examination. Use the books a week and notify us to get them back if they don't please you. If you like them send us only \$2.80 in 7 days and \$3.00 each month until \$19.80 is paid. Send the coupon NOW and get the books at a greatly reduced price. Remember—sending for the books does not obligate you to buy.

American Technical Society
Dept. G-720
58th St. and Draxel Ave.
CHICAGO



Free Examination Coupon

American Technical Society
Dept. G-720
CHICAGO

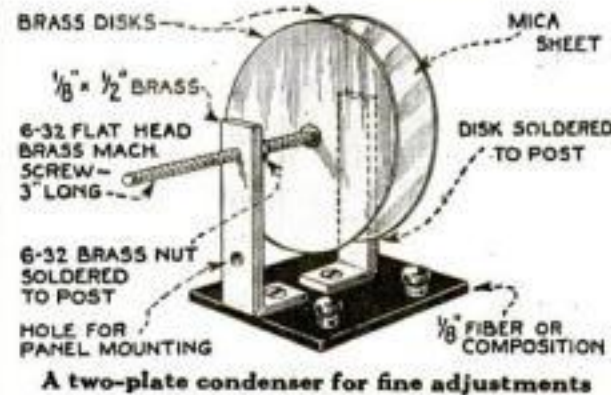
Please send me the 5 volume Cyclopedia of Carpentry and Contracting, shipping charges collect. I will send you \$2.80 in seven days and \$3.00 each month until \$19.80 is paid or notify you to send for the books at your expense.

Name.....
Address.....
City..... State.....
Employed by.....
Please fill out all these lines

Micrometer Variable Condenser Made for a Few Cents

FOR a few cents a radio fan can make a micrometer variable condenser that will give exceptionally sharp tuning in connection with a large condenser or used alone where critical adjustment of capacity is required in a hook-up.

The condenser plates are two brass or zinc disks. One is soldered to a brass support, as shown, and the other is soldered to the head of a 6/32 brass machine screw 3



A two-plate condenser for fine adjustments

in. long. A 6/32 nut is soldered opposite a hole in another brass support and the machine screw turned into it. The two supports are then screwed to a 1/8-in. fiber or composition base. A thin piece of mica is shellacked to the stationary disk to prevent the plates from causing a short circuit.

Drill holes for the binding posts and solder a wire from each to one of the supports. A dial and knob are fastened to the machine screw, a brass shim being soldered to the screw, if necessary, to make them fit. Turning the knob moves the plates nearer or farther apart by very fine degrees.—EDWIN G. GETTINS, Los Angeles, Calif.

Testing Radio Crystals Quickly

TO SAVE time in testing the relative merits of a number of mounted and unmounted radio crystals, I use the simple detector stand illustrated in place of the regular glass-covered detector on my set. Each crystal to be tested is placed on the



The crystals are turned under catwhisker

copper tray with the tweezers, pushed under the catwhisker, and manipulated until the surfaces have been thoroughly tried out. Either the signals of a broadcasting station or a buzzer can be used for the test.

The base is a block of wood 1/2 by 2 1/2 by 2 1/2 in. A piece of thin copper or brass is bent up on three sides to form a tiny, shallow tray, fastened to the wood with escutcheon pins, and connected with one binding post. The catwhisker, with its end clipped to a sharp point, is mounted as shown and connected with the other post.—S. L. P.



\$500 REWARD for TWO HOURS' WORK

In answer to a request from Chief of Police, Warren Biglow, the Finger-Print Expert arrived at the scene of the daring robbery of the O— Company offices. \$6500.00 in currency was gone. Not a single clue had been found.

Almost immediately Biglow turned his attention to a table which had been tipped up. The glossy mahogany showed an excellent set of finger prints. The thief might just as well have left his calling card.

To make a long story short, his prints were photographed, and matched with those of "Big Joe" Moran, a safe blower. Moran was caught and convicted on Biglow's finger print proof. The money was recovered and a \$500.00 reward given to Biglow, in addition to his fees—as pay for his two hours' work.

Be a Finger-Print Expert Learn at Home in Spare Time

No more fascinating work than this—and big rewards go to the EXPERT. Thousands of trained men are now needed. The Finger Print work of governments, corporations, police departments, detective agencies, banks, individuals, has created a new profession. Many experts earn \$3,000.00 to \$10,000.00 a year. And now you can easily learn the secrets of this new science in your spare time—at home. Any man with a common school education can become a Finger Print Expert in a short time.

Free Finger-Print Outfit and Course in Secret Service

We are making a special, limited offer of a complete Professional Finger-Print Outfit and a Course in Secret Service Intelligence, both absolutely FREE. Mastery of these two professions offers you a brilliant career.

Send Today for FREE BOOK



Write quickly for fully illustrated free book on Finger Prints which explains this wonderful training in detail. Don't wait until this offer has expired—mail the coupon now. You may never see this announcement again! You assume no obligation—you have everything to gain and nothing to lose. Write at once—address

University of Applied Science
Dept. 93-67 1920 Sunnyside Ave., Chicago, Ill.

UNIVERSITY OF APPLIED SCIENCE
Dept. 93-67 1920 Sunnyside Ave., Chicago, Ill.
Gentlemen:—Without any obligation whatever, send me your new, fully illustrated, FREE book on Finger Prints and your offer of a FREE course in Secret Service Intelligence.

Name.....
Address..... Age.....
Town..... State.....

BUILD YOUR RADIO SET *with* WORKRITE Radio Parts

When you build a Radio Set yourself you save a lot of the cost over buying a complete set. When you build your set with WorkRite Radio Parts you know that it will be the best there is, regardless of cost. Concerts have been heard entirely across the continent on a set made with the

WORKRITE TUNER TEAM



WorkRite 180° Super Variocoupler



WorkRite Super Variometer

Two WorkRite Variometers and one WorkRite Variocoupler make up the Famous WorkRite Tuner Team. Highest Quality instruments. Range 150 to 705 meters. 3/16" shafts. Look at this remarkable price for these instruments.

WorkRite Variometer each \$3.50
WorkRite Variocoupler each

WORKRITE RADIO PARTS WORK RITE

Send 5c in stamps for catalog and hookup.

The WorkRite Mfg. Co.,
5533 Euclid Ave., Cleveland, Ohio

Please send me your catalog of Radio Parts and hookup for making a Radio Set.

Name.....

Address.....

Fountain Pen Ink Bottle Turned into Spirit Lamp

WHEN you have drained one of those handy filler-top desk bottles of fountain pen ink, the empty bottle can be converted into a spirit lamp for the workshop or laboratory.

Nick the glass filler with a file just where it starts to contract in size, and snap it off clean. Then cut off the rubber bulb, draw



A cheaply made alcohol burner

the glass tube out of the stopper and insert it from the other end with its flared end down. A piece of cotton wicking and a little denatured or wood alcohol make the lamp ready to use.

The flared lower end of the glass tube permits the wick to be drawn up as it is needed, by means of a pin. The sharp upper edge holds it from slipping back. The original metal screw cap acts as an extinguisher and keeps the alcohol from evaporating through the wick when not in use.—F. M. W., Jr.

Locked Barrel Is Useful for Storing Heavy Tools

ALTHOUGH heavy and large tools are almost invariably stored in the corner of the shop or barn because of the lack of a suitable box, this practice often results in loss or breakage.

A substantial and serviceable container for such tools is a tight coopered barrel, fitted with a reinforced cover, hinges, and a hasp. Such a storage place takes up little room and costs next to nothing, and the tools will always be found when wanted.

A locked barrel is a container of such large capacity that it is also useful for safeguarding other materials, such as harness, fuel, and oils.—L. A.



For large tools and bulky supplies

Making Shrink Fits

WHEN shrinking small parts together, it is not easy to obtain the precise fit necessary so that the outer part, when heated, will just slip over the inner. It is a matter of cut and try, plus care and experience. There is one little kink, however, that often has been found useful. If the fit has been made a trifle too close, so that the parts will not go together when the outer part is heated, it often will help matters to shrink the inner part slightly by putting it on ice until it is thoroughly chilled. When the two are assembled, there will be shrinkage from the outside and expansion from the inside. The work must be done quickly and there's some danger, if the outer part is not fairly substantial, that it will rupture from the pressure.—H. G.

UNITED STATES AND FOREIGN PATENTS PROTECT YOUR RIGHTS

PATENTS

Any new article, machine, design or improvement thereof, or any new combination of parts or improvements in any known article which increases its efficiency or usefulness, may be patented, if it involves invention.

IF YOU HAVE ANY NEW IDEAS

which you feel are useful, practical and novel, take prompt action toward protecting your rights. If you have invented any new machine, or new combination of parts or improvement, or new process or design,

Send Drawing, Model or Description

of it for information as to procedure to secure protection.

WRITE TODAY FOR BLANK FORM

Record of Invention

to be returned to me with drawing, description or model of your idea. Promptly upon receipt by me of your idea I will write you fully as to procedure and costs.

No Charge for the Above Information

All communications are held in strict confidence. My personal, careful and thorough attention is given to each case. I offer you efficient, reliable and prompt service—based upon practical experience. Highest references.

Write today for free book "How to Obtain a Patent." This book will give you valuable information, and it may save you much time and effort. Send for it NOW.

My practice is devoted exclusively to United States and foreign patents and trade marks. Very probably I can help you. Write today.

CLARENCE A. O'BRIEN

Registered Patent Attorney
224 Southern Bldg., Washington, D. C.

CLARENCE A. O'BRIEN,
224 Southern Building,
Patent Attorney,
Washington, D. C.

Please send me your free booklet, "How to Obtain a Patent" and blank form Record of Invention without any obligation on my part.



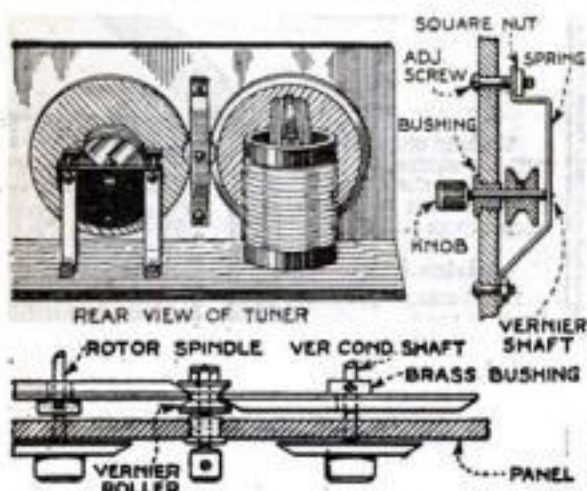
NAME.....

ADDRESS.....
(WRITE PLAINLY)

One Knob Provides Vernier for Two Radio Instruments

THE unusual feature of this Vernier control for a radio receiving set is that a single knob operates both the rotor of a variocoupler or variometer and a variable condenser. The operator makes fine adjustments of either without removing his hand from the knob, and this, of course, makes close tuning easier than if individual Verniers were used for the instruments.

Two disks of fiber or maple are turned, each with one beveled edge, and fixed to



Details of dual Vernier control. Note that the variocoupler and condenser are base mounted to allow room for the large disks

the shafts, as shown, by setscrews in their brass bushings. One beveled edge faces the front and the other the rear.

The roll is turned from fiber with two beveled surfaces facing each other. It is fixed to a floating shaft free to work in a brass bushing anchored in the panel. The pointed end of this shaft engages a hole in a bent-up flat spring, which is attached to the rear of the panel as shown.

The tension forces the beveled surface of the roll against the disk that has its beveled edge facing the rear and when the Vernier knob is turned, that disk moves. To turn the other disk, the knob is pushed in, thus forcing the roll in contact with the beveled edge of the second disk and out of contact with the first. This allows microscopic adjustments of both instruments to be made until precisely the correct tuning has been obtained.—C. M. WILCOX.

Waterproofing Shoes

SHOES can be made thoroughly waterproof at home by using any of the formulas given below. These have been



The sole is placed in grease that is warm but not hot for fifteen minutes

tested by the U. S. Department of Agriculture.

Formula 1: Neutral wool grease, 8 oz.; dark petrolatum, 4 oz.; paraffin wax, 4 oz. Formula 2: Petrolatum, 1 lb.; beeswax, 2 oz. Formula 3: Petrolatum, 8 oz.; paraffin wax, 4 oz.; wool grease, 4 oz.; crude turpentine (gum thus), 2 oz. Formula 4: Tallow, 12 oz.; cod oil, 4 oz.

In each case the ingredients should be warmed and stirred until they have been thoroughly melted and mixed together.—E. A. HIGGINS, New York.

PATENTS TRADE-MARKS AND COPYRIGHTS

SPECIAL OFFER FREE OPINION AS TO PATENTABLE NATURE

Before disclosing an invention, the inventor should write for our blank form "Record of Invention." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention, we will give our opinion as to its patentable nature.

Our Three Books Mailed Free to Inventors

Our Illustrated Guide BOOK

HOW TO OBTAIN A PATENT

Contains full instructions regarding U. S. Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described, Articles on Assignment or SALE OF PATENTS, Patent Practice and Procedure, and Law Points for inventors.

OUR TRADE MARK BOOK

Shows the value and necessity of Trade-Mark Protection and gives information regarding Trade-Marks and unfair competition in trade.

OUR FOREIGN BOOK

We have Direct Agencies in all Foreign Countries. We secure Foreign Patents in shortest-time and lowest cost.

LIST OF PATENT BUYERS SENT FREE

IDEAS WANTED: Send for LIST OF PATENT BUYERS, containing unsolicited Letters from Manufacturers and others WISHING TO BUY meritorious patents. There is a great demand for NEEDED INVENTIONS. We endeavor to assist OUR clients in the commercial development of their inventions.



Specification and Drafting Departments, Victor Building, Washington, D. C.

FREE COUPON



VICTOR J. EVANS & CO. Patent Attorneys

New York Offices 1007 Woolworth Bldg. Philadelphia Offices 714-715 Liberty Bldg. Pittsburgh Offices 514 Empire Bldg. Chicago Offices, 1114 Tacoma Bldg. San Francisco Offices, Hobart Bldg. Main Offices, 760 9th Street, Washington, D. C.

Gentlemen: Please send me FREE OF CHARGE your books as described above.

Name.....Address.....

BOYS



Learn ELECTRICITY

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into good positions and get experience that will give them a real start toward success in life. Good salaries are offered with rapid promotion.

For 30 years the International Correspondence Schools have been training boys for success in electricity and over 300 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help you. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 7657-C, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject before which I have marked an X:

BUSINESS TRAINING COURSES

- | | |
|---|---|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Advertising |
| <input type="checkbox"/> Personnel Organization | <input type="checkbox"/> Better Letters |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Foreign Trade |
| <input type="checkbox"/> Business Law | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Banking and Banking Law | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Accountancy (including C.P.A.) | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Nicholson Cost Accounting | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Common School Subjects |
| <input type="checkbox"/> Private Secretary | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Business Spanish | <input type="checkbox"/> Illustrating |
| <input type="checkbox"/> French | |

TECHNICAL AND INDUSTRIAL COURSES

- | | |
|---|--|
| <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Architect |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Blue Print Reading |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Contractor and Builder |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Architectural Draftsman |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Concrete Builder |
| <input type="checkbox"/> Railroad Positions | <input type="checkbox"/> Structural Engineer |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> Chemistry |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Automobile Work |
| <input type="checkbox"/> Metallurgy | <input type="checkbox"/> Airplane Engines |
| <input type="checkbox"/> Mining | <input type="checkbox"/> Agriculture and Poultry |
| <input type="checkbox"/> Steam Engineering | <input type="checkbox"/> Radio |
| <input type="checkbox"/> Mathematics | |

Name.....
Street.....
Address.....
City..... State.....

Occupation.....
Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada.

AGENTS BRAND NEW KNIFE SHARPENER

Here's the simplest and most practical Knife Sharpener ever invented. Puts a keen edge on any kind of knife. Wonderful Seller—every home wants—show it—a sale is made. Big profits for hustlers—easy to make \$2.00 an hour. 350 other fast selling Household Articles. Get the Agency—your chance to clean up. Write quick—today—territory going fast.

The American Products Co.
8893 Third St. Cincinnati, O.



A DAY PROFIT

PATENTS

TRADE-MARKS, COPYRIGHTS AND PATENT LITIGATION
Write for advice and instructions how to proceed, costs, etc.
Hand Book with illustrations of 100 Mechanical Movements sent free on request.

ALBERT E. DIETERICH
Patent Lawyer and Solicitor

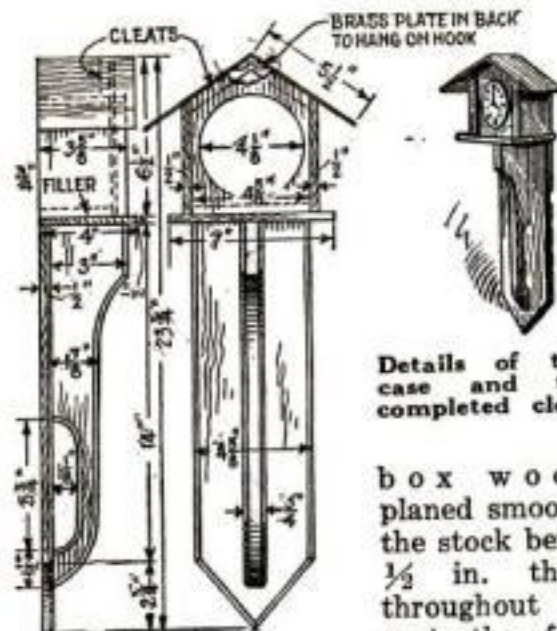
Successor to Fred G. Dieterich & Co.
60 Ouray Bldg. WASHINGTON, D. C.

Handy Wall Case Improves Cheap Alarm Clock

BY THE addition of the case illustrated, a common alarm clock can be used as a wall clock during the day and as an ordinary alarm clock at night. The case, if neatly made and carefully finished, converts even the cheapest alarm clock into a clock of attractive appearance.

I made the first of these cases for the shop, where an alarm clock kept on a shelf had been knocked down again and again. I have since made several others.

The cases were mostly built of packing-



Details of the case and the completed clock

box wood planed smooth, the stock being $\frac{1}{2}$ in. thick throughout except the face

mat or frame, which is only $\frac{1}{8}$ in. thick. The grain of this piece should run up and down and the circle be cut to suit the clock.

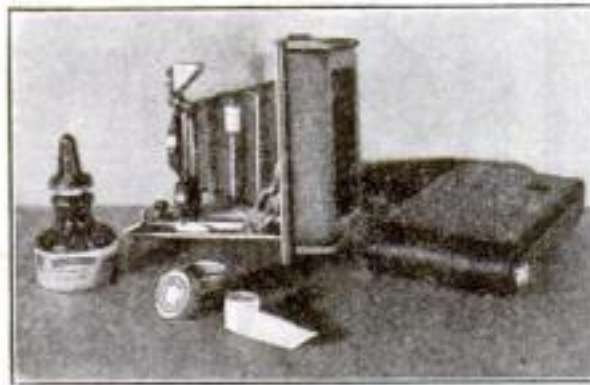
The gable in the case shown is at an angle of 30 degrees. A filler piece is required to raise the clock a trifle off the floor. I have a $\frac{3}{4}$ -in. block in my case at home, but have found $\frac{1}{2}$ -in. blocks better for other types of alarm clocks. The front frame is glued to this filler piece and it, in turn, is nailed to the bottom of the case.

A small piece of brass at the back holds the roof together and provides means for hanging the case up. The handle is $\frac{3}{4}$ in. thick but can be made of $\frac{1}{2}$ -in. stock. The completed case is stained and varnished.—ERNEST I. C. ERLANDSON, Alameda, Calif.

Repairing Camera Bellows

ZIGZAG marks or patches sometimes found on films taken by amateur photographers are very often due to small holes in the bellows of a folding camera.

To locate such defects remove the back of the camera and hold it up to the sun, with the shutter closed and place a black



The minute holes are patched with adhesive tape

cloth over your head to exclude the light. Cover the hole or holes when found with adhesive tape or plaster, preferably such as is used in medical work, and blacken the patch with India drawing ink applied with the filler quill or a small brush.—EDWARD H. FLAHERTY, Denver, Colo.

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. Your brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation"—and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

201 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c.

PATENTS

To the Man With an Idea

offer a most comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
Patent Lawyer

6 Owen Building, Washington, D.C.
2276-D Woolworth Building
New York City



\$50,000.00

Reward Dead or Alive

Toronto, Can., Millionaire Missing

BE A DETECTIVE Be a

Print Specialist. Learn Scot-

land Yard Methods. Experi-

ence not necessary. Write to-

day for FREE illustrated

booklet

United Detective Training Ass'n

807 Dinan Bldg., Detroit, Mich.

INVENTORS who derive largest profits know and need certain simple but vital facts before applying for Patents. Our book Patent-Sense gives those facts: free. Write Lacey & Lacey, 648 F St., Washington, D. C. ESTABLISHED 1869.

How to Rebuild an Old Car

(Continued from page 114)

place it away and remove the body, having first dismantled all fenders, aprons, wiring, and other connections that might interfere with lifting it. Next, remove all tires and rims and then run the chassis out where you can take a paint brush with stiff bristles, a putty knife, and several gallons of kerosene to clean the exposed parts.

There is real fun in overhauling the bus, but no one likes to be dirty all the time. So clean it and have done with the road oil and general grime and dirt. The glisten of the aluminum crankcase alone repays you for the effort.

Now, I shall have to leave, but if you will get that chassis really clean before you go any farther, I will lay out a few jobs for you:

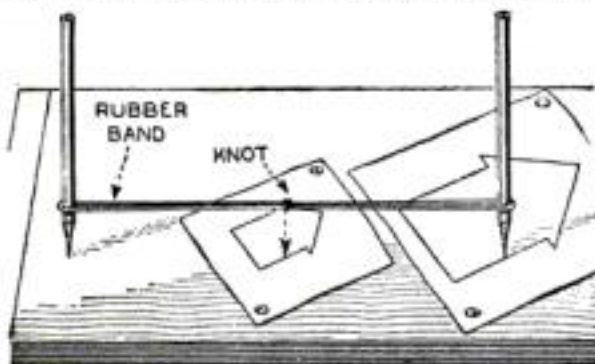
1. Clean chassis.
2. Remove all units from the frame.
3. Inspect frame for cracks, loose rivets, and bends.
4. Renew all bushings in springs, if the old ones are badly worn.
5. Graphite all spring leaves after taking them apart and sanding them to remove rust. Reassemble springs.
6. Rebush the pivot pins and the tie rod yokes. Inspect and overhaul the front axle.

I will return next month to see how clean you have the chassis and whether you make a good job of the new bushings. Then we will take up the work of overhauling the rear end, the transmission and clutch, and, if we have time, the engine itself.

Enlarging Sketches with Rubber Band and Pencils

THERE are a number of ways of enlarging or reducing sketches, but the simplest method that I know is the one illustrated below. An ordinary rubber band and two pencils does the trick, or a rubber band, a lead pencil, and a pen.

Put a knot in the rubber band close to the center, as shown. If the knot is made exactly in the center, the enlargement will be twice the size of the original; by placing



The knot in the elastic is kept constantly over the line being copied by the right-hand pencil; the left-hand pencil remains stationary

the knot one third of the distance, the enlargement will be 3 to 1; one fourth, 4 to 1.

The rubber band is placed around the pencils, and one pencil is held stationary while the other pencil is used for making the enlarged drawing. The direction and length of the line are regulated by watching the knot, which must be kept exactly on top of the line that is being copied.—W. F. SCHAPHORST, M.E.

To AVOID bubbles in varnish, never shake a varnish can before pouring, and pour the varnish with the outlet uppermost.

Yes — why don't you?



Is your battery always fully charged and fit?

Is it always toned up for best results, whenever friends happen in—throughout every concert?

Keep it at full strength and prolong its life—the simple, easy, inexpensive Tungar way.

Tungar—the go-between from house-lighting circuit to storage battery—attaches wherever there is a lamp or convenience outlet.

You don't have to move the battery. Just connect Tungar, and leave it—any time, day or night.

Tungar is certain, clean, quiet. No moving parts to get out of order or make noise.

Good for the auto battery too—the same Tungar.

See one at any good electrical store, or write for literature. Address Section P10.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

Tungar Battery Charger. Operates on Alternating Current.
2 Ampere Outfits—\$18.00
5 Ampere Outfits—\$28.00
(Prices east of the Rockies)
Special attachment for charging 12 or 24 cell "B" Storage Battery—\$3.00—fits either size Tungar.



Charge 'em at Home, with

Tungar

BATTERY CHARGER

A GENERAL ELECTRIC PRODUCT

35A-960

Motorcycle Bargains

SAVE 25% to 65%

on Slightly used and Rebuilt Motorcycles, Ace, Indian, Excelsior, Harley-Davidson, Cleveland, Side Cars, Johnson Motor Wheels, Evans Power Cycles, Bicycles. Send for Free Bargain Bulletin and Money Saving Message, listing hundreds of Bargains in used, rebuilt and new machines, supplies, accessories, etc.

AMERICAN MOTOR CYCLE CO.

Dept. 1026, 2047 W. Chicago Ave., CHICAGO



Sell Shirts



Sell Madison "Better-Made" Shirts, Pajamas, and Nightshirts direct from our factory to wearer. Nationally advertised. Easy to sell. Exclusive patterns. Exceptional values. No experience or capital required. Large steady income assured. Entirely new proposition. WRITE FOR FREE SAMPLES.

MADISON SHIRT CO., 603 B'way, N.Y. City



The Hand That Rocks The Cradle Can Also Swing The Brush

WHITING-ADAMS BRUSHES

Insure even tempers on odd jobs.

Send for Illustrated Literature

JOHN L. WHITING-J. J. ADAMS CO., Boston, U.S.A.

Brush Manufacturers for Over 114 Years and the Largest in the World

96

Smashing Reduction!



**BOXING,
Jiu-Jitsu,
Wrestling**

\$1.97
Plus actual postage

Here's your chance to get the famous Marshall Stillman Boxing Course for the price of a good necktie. Six books clearly printed on fine paper, over 240 half tone illustrations. The most scientific method of teaching boxing ever devised.

You should see all the letters we receive regarding the wonderful results obtained. Some subscribers have whipped men 30, 50 and 60 lbs. heavier than themselves. Even professionals who have taken the course are enthusiastic.

Marshall Stillman teaches by association of ideas. You hold out your hand as though for a coin, lower your head like a goat butting, etc. Then you are led to similar movements in hitting, ducking, etc. You learn quickly and never forget. Soon you are feinting, ducking, sidestepping, blocking and hitting like a veteran.

FREE book included containing lives of 69 famous boxers with little known stories.

Also a book devoted to the wonderful art of Jiu Jitsu.

10-Day Trial—Send No Money

Simply mail the coupon. When you receive the course, deposit 97 cents plus actual postage. Try it out for 10 days. Then send us the small final payment of \$1, or return the course, and we'll send your deposit back.

COUPON

MARSHALL STILLMAN ASSOCIATION
Dept. 1123-K, 42nd St. and Madison Ave., New York

You may send me on approval the Marshall Stillman Course. I will deposit 97 cents (plus actual postage) with the postman, with the understanding that if, after 10 days, I wish to return the course, I may do so and my money will be instantly refunded. If I keep the course I am simply to send you \$1 in final payment.

Name.....

Address.....
Canadian and foreign orders must be accompanied by cash (\$1.97 U. S. funds) subject to money back guarantee if not entirely satisfactory.

\$25.00 in PRIZES

See top of page 4 in front of book for full details.

COAL IS MONEY save it

It's costing you real money to be without the CROWN Fuel Saver. One user says—"I have burned only half the amount of coal. The CROWN has eliminated all coal gas—holds the fire nearly twice as long—gives more heat." (Name on request.)

Why not keep in your own pocket some of the money you now give the coalman?

It's simply lack of hot air over the surface of the fuel bed in your furnace that costs you extra money for coal. The CROWN remedies this; and reduces your coal bills 20 to 50%.

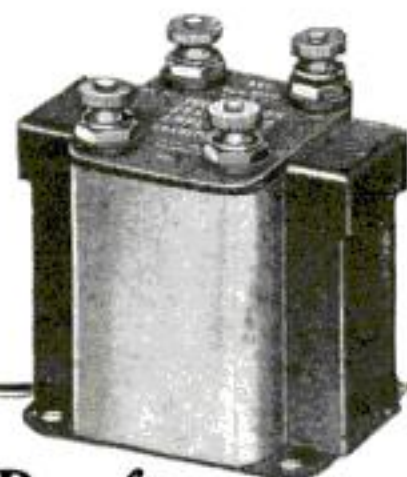
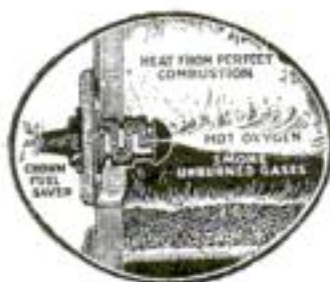
The CROWN Fuel Saver fits the feed door of any heating plant. An ordinary mechanic can install it in short order without injuring the feed door. The CROWN introduces, by means of natural draft, the supply of super-heated air necessary to burn the rich gases that ordinarily go up the chimney as "smoke."

The CROWN saves this unnecessary waste of fuel. This means a tremendous increase in heat and a corresponding reduction in smoke. The CROWN pays for itself in coal saved. Can you afford to be without it? Decide now. Write for our booklet—"Making the Coal Bill Look Like 30 Cents"—and for details and price of CROWN. As the CROWN comes in four sizes give name and make of furnace and approximate size of grate. You'll save money by writing today.

DISTRIBUTORS WANTED

High grade men can create a profitable permanent worthwhile business with the CROWN. It's a fast seller. Write or wire for details or appointment.

CROWN FUEL SAVER CO.,
12 N. 10th St., Richmond, Ind.



Performance!

You judge the value of a product by the service it has given you—not only by the claims advanced for it by its manufacturer.

An investigation of the Thordarson Audio Frequency Transformer will show you.

1. A splendidly designed case.
2. A square core of .007 mil. highest grade silicon steel, No. 36 gauge, carefully cut by a patented process.
3. A square layer wound coil, carefully wound by machines of our own development. Between each layer of wire is finest grade condenser paper, guaranteed and tested to withstand 600 Volts D. C. without breakdown.
4. A test of its amplification will convince you that its volume is greater over all bands of audio frequency, and that distortion is eliminated to a degree not found in any similar transformer of any price or manufacture on the market.

That these statements are true is attested to by the tendency of other transformer manufacturers to adopt many of the Thordarson principles.

That manufacturers of receiving sets are specifying Thordarson transformers and variable condensers is further evidence of the superior performance and dependability of our products.

The best radio dealers sell and highly endorse Thordarson equipment.

PRICE, MOUNTED ONLY

6 to 1 ratio transformer . . . \$4.50
(with Red Label)
3½ to 1 ratio transformer . . . 4.00
(with Blue Label)

THORDARSON
ELECTRIC MFG. CO.

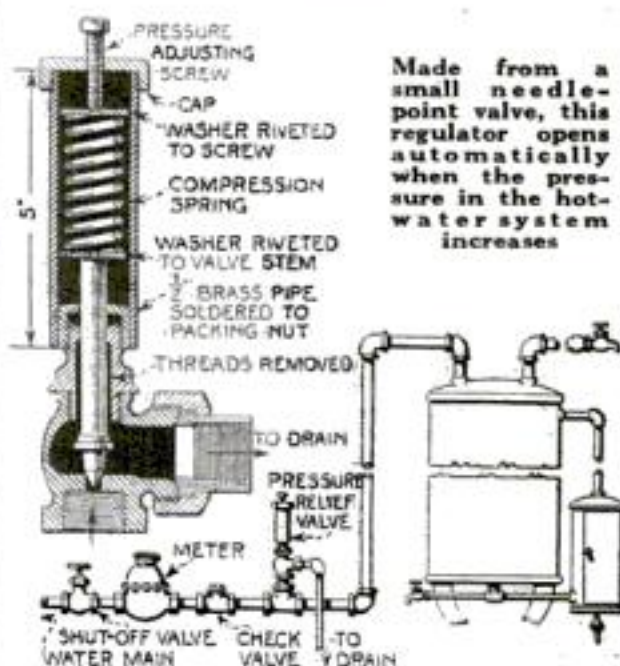
Huron and Kingsbury Streets, Chicago, Ill.

Hot-Water Relief Valves Prevent Waste and Leaks

By John H. Schalek

ASIDE from corrosion, the greatest annoyance experienced by the householder is that of leaking joints in the so-called "closed system" of water heating. In this system there usually is a check valve, which prevents the hot water's backing into the meter and damaging the hard rubber parts.

Because of the check valve, the accumulation of heat in the water at such times when little or no water is used, raises the pressure in the piping and tank to an alarming extent. An increase in water temperature from 60 to 100° F. may bring the pressure in a closed system up to 240 lbs. a square inch, assuming an initial water pressure of from 60 to 70 lbs. This is more than twice the pressure that the average hot water tank is designed to withstand. As soon as a faucet is opened, the pressure immediately drops to 60 or 70 lbs. Build-



Made from a small needle-point valve, this regulator opens automatically when the pressure in the hot-water system increases

ing up and releasing this abnormal pressure several times each day cannot but have a damaging effect on the whole system and usually is the cause of leaks.

Fortunately, in many cases there are sufficient leaking faucets to act as a safety vent for this pressure. Only a few drops a minute are required to keep the pressure below the danger point. To release this pressure automatically, the device illustrated was developed from a needle-point valve having a 1/8-in. valve opening. The screw thread was filed off, allowing the stem to move up and down freely.

As soon as the pressure reaches a point beyond the counteracting pressure of the spring, the valve stem is lifted from its seat and the excess water discharged from the system. The amount of water is insignificant, but when the device is in use, the pressure in the water heating system may be kept almost as low as the city pressure.

Joining Sewing-Machine Belts

IN REPAIRING a broken sewing-machine belt, the home mechanic often has difficulty in finding a piece of soft wire the right size to bend into a connecting link. A length of No. 16 or No. 18 gage soft iron wire of exactly the proper size can be obtained by tearing off the cover of an old tobacco tin of the type shown and using the hinge pin.—W. B.



Gilded Picture Frames Made without Special Moldings

TO MAKE gilded picture frames without rabbeted molding or any expensive materials is not particularly difficult. The stock for the frames should be $\frac{1}{8}$, $\frac{3}{16}$ or $\frac{1}{2}$ in. thick and $2\frac{1}{2}$ in. wide for small sizes, and $\frac{1}{4}$ or $\frac{3}{8}$ in. thick and 3 or 4 in. wide for larger pictures.

Cut the angles not a true miter but a little less than 45 degrees, so that when the sides



The frame is painted with glue and barley, rice, or other grains are spread thickly over it

are glued and nailed together, they will slant inward a trifle. The slope should be noticeable but not too pronounced.

When the frame has been assembled, spread glue over its outer surface and outer edges, and while it is still wet, sprinkle rice over it to form an uneven and slightly wavy surface. When dry, this surface is gilded with metallic paint—gold, bronze, or

Mounting the picture on the glass (at right). The framed picture (below)



silver. If desired, the rice can be arranged by the use of a stencil to form an ornamental design, and the contrast between the various parts

can be heightened by using grains of various sizes.

If the picture is a printed one, moisten it on the back with water, spread it carefully on clean glass of the proper size, lap the waste edges over the glass and glue them in place. A photograph is mounted on cardboard and the cardboard is glued to the glass with strips of paper. An oil painting is mounted on cardboard and treated in the same way, but if on a stretcher, it can be fastened to the frame directly with brads.

"Junking" an Old Auto

YOU can often obtain more money for an old car if you "junk" it yourself than if you sell it intact to a junk dealer. Wreck the machine and separate the various kinds of metal. Sell the metal as scrap, and whatever is too bulky to get rid of in this way, dispose of to the junkman.

If you haven't time to do the job yourself, make a deal with some boy to do it for you.

In one case no dealer would offer the owner more than \$15 for the entire machine. Finally he "junked" the car himself and sold the metal and scrap for approximately \$60.—G. W. GREENE, New Bedford, Mass.



Learn Mechanics In 8 Weeks At Sweeney's

WHY not make your work play by working at what you like? If you like machinery, if you are mechanically inclined, and are game, are not afraid of working in grease, gasoline, you and I will get along together fine.

I cannot teach any man a trade if he does not like his work. If you don't like to work in the dirt, grease, among machinery, you are not mechanically inclined. If you are, write me, and write me NOW! Don't put it off, but get busy, get your pencil, fill out the coupon in the corner, and mail it to me for my book.

GET INTO THE AUTOMOBILE BUSINESS BY THE

Sweeney System of Practical Experience

The Great Million-Dollar School, world-famous, and the success of my thousands of graduates are due to the Sweeney system.

This is what you get here and can't get anywhere else. I have taught over 60,000 men to be expert repair men, chauffeurs, tractor engineers, garage owners, etc. I am proud of the fact that I was selected by the U. S. Government to train 5,000 men for mechanical work in the service. I teach by using tools not books. You learn as you do the real work with your hands.

Be Your Own Boss

You can be your own boss. This is the yearning of every young man and Sweeney makes it possible. Twenty thousand Sweeney Trained Men own their own garages, tire shops, vulcanizing and service shops. It is easy to start in business for yourself and you don't have to bow down to some employer and do work you don't like. You can be independent—work for yourself with enthusiasm—awake every morning with the thought "what I make today is mine." Think what it would mean to see your name over the door of a good paying business. Lots of fellows with money are often looking for trained men to handle the mechanical end as partners. Sweeney Training fits you for just such big opportunities.

I PAY YOUR RY. FARE

If you will come now I will help by paying your railway fare from any point in the U. S. to the Sweeney School. I will also give you a FREE RADIO COURSE. I will also tell you about my New Offer—a wonderful opportunity for you! The first step is to send for my Free Catalog. Get all the facts.

FREE

Simply send name today for my big 64-page catalog. Shows hundreds of pictures of men at work in the school. Tells all about wages, profits, opportunities in auto and tractor business. Explains step by step how you learn. Interesting letters from graduates telling how they made good. Shows how men come from all over the world to this big school. Makes you want to join the crowd. Tells everything you want to know. No cost, no obligation. Clip the coupon, or a postcard will do. Get the catalog now—that's the first step. Don't put it off one minute. No colored students accepted.

E. J. SWEENEY, President

LEARN A TRADE-
Sweeney
AUTOMOTIVE & ELECTRICAL SCHOOL
1189 SWEENEY BLDG. KANSAS CITY, MO.

E. J. SWEENEY,
Dept. 1189,
Kansas City, Mo.
Send me full details.

Name.....

P.O.

State.....

ONLY \$1.80

for this strength-tested, pocket-size 3-blade screwdriver.

SIMORE LIGHTNING CHANGE SCREWDRIVER

Blades selected and produced by gravity, and they lock into position with just a turn of the knurled cap at the base of the blade. When finished a thumb's touch releases the blade which disappears instantly into the handle.

CHANGES BLADES Instantly - Automatically

No loose blades, no lost blades, always ready for use. Once you try it—you won't be without it. SEND NOW money order or check for \$1.80.

The Simon & Skidmore Mfg. Co.
Dept. 510 Santa Ana, Calif.



Guaranteed satisfactory or money refunded

197 Direct Factory Price for Limited Time Only Double-Heat ELECTRIC STOVE



Newest, neatest, most economical of all electric stoves, the Double-Heat does your cooking

quicker, better, cheaper. Toasts, fries, boils in half usual time. Full size heating surface. New metallic treatment reflects back ground to heating element utilizes all the heat. Operates on any lighting socket, direct or alternating current.

Direct From Factory on Approval

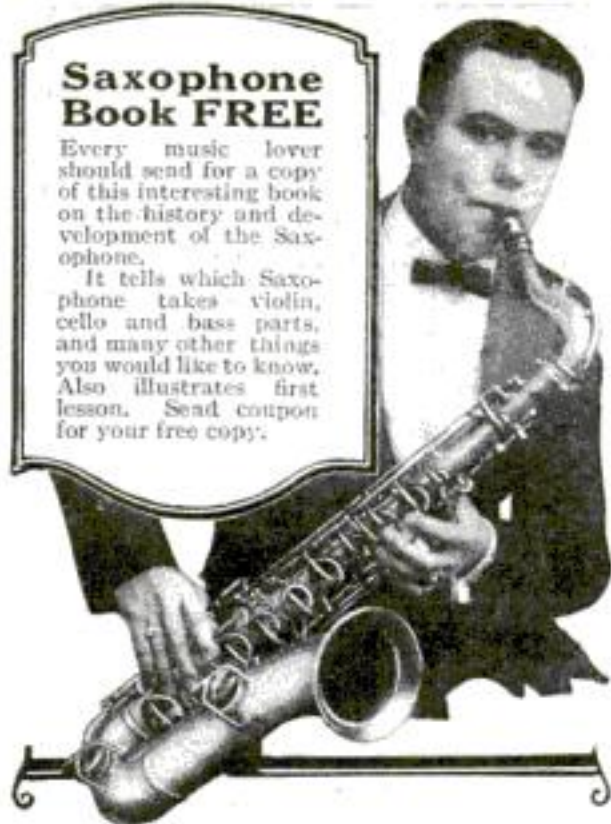
SEND NO MONEY

Amazing offer! Only \$1.97—and on approval! Just pay postman upon arrival, plus a few cents postage. One year full durability guarantee. If not delighted, return in five days, and every penny refunded. Order quick! Only limited number at this introductory price. Acorn Brass Mfg. Co., 1035 Factory Bldg., Chicago, Ill.

Saxophone Book FREE

Every music lover should send for a copy of this interesting book on the history and development of the Saxophone.

It tells which Saxophone takes violin, cello and bass parts, and many other things you would like to know. Also illustrates first lesson. Send coupon for your free copy.



Saxophone Players in Big Demand

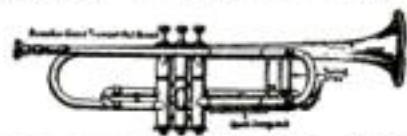
For Bands and Orchestras, for church, lodge and school musical affairs, for social and home entertainment, the Saxophone is the most popular instrument and one of the most beautiful. A good Saxophone player is always popular socially and enjoys many opportunities to earn money. Saxophone players are always in demand for dance orchestras. Every town should have a Saxophone quartette or orchestra.

BUESCHER

True Tone Saxophone

Easiest of all wind instruments to play and one of the most beautiful. With the aid of the first three lessons, which are sent free (upon request) with each new Saxophone, the scale can be mastered in an hour; in a few weeks you can be playing popular music. Practice is a pleasure because you learn so quickly. You can take your place in a band within 90 days, if you so desire.

Buescher-Grand Trumpet



Especially easy to blow, with an improved bore and new proportions. With the mute in, it blows so softly and sweetly that it will not annoy anyone. A splendid home instrument.

Free Trial—Easy Payments

You will be allowed six days' free trial of any Buescher Grand Saxophone, Cornet, Trumpet, Trombone, or other instrument. Easy terms of payment can be arranged. Mention the instrument interested in and a complete catalogue will be mailed to you free.

Buescher Band Instrument Co.

Everything in Band and Orchestra Instruments
3113 Buescher Block Elkhart, Indiana

Buescher Band Instrument Co.
3113 Buescher Block, Elkhart, Ind.

GENTLEMEN:

I am interested in the instrument checked below:
Saxophone... Cornet... Trombone... Trumpet...
(Mention any other instrument interested in.)

Name.....

Street Address.....

Town..... State.....

Our Silent Partners

(Continued from page 42)

land. In the water they could merely drift about and settle anywhere until the bottom was peopled. On land they are fixed. In the partition of advantages between plants and animals in the very beginning, plants had received the great advantage of self-feeding, but they gave up to the animals the advantage of voluntary motion. How, then, could they contrive to extend themselves on land until they conquered all of it, even the parts that are farthest from the sea?

The doing of this has involved what botanists call the means of dispersal, the way, that is, by which a certain kind of plant can extend the region in which it grows. This had begun even before the invention of seeds. Some ferns, for example, possess a kind of running root that creeps out underneath the soil and comes up many feet away to make new plants. Again, it was one of the original advantages of the alternation of generations that the smaller plant of the two might blow off somewhere in a wind or float about on the water and thus start a new colony of its kind.

How Seeds Are Dispersed

But none of these means was very rapid or efficient and real success in this problem of dispersal came only after the seed (and certain similar devices like the spores of mosses) had been perfected. A seed, obviously, can go a long way safely if you can get something to carry it, so plants have devised several such carriers. Some seeds, for example, have fluffy fibers on them like the seeds of thistle-down. Others have wings like the seeds of the maple tree. These are aviation devices, ways to get seeds carried off more or less distantly by the wind. Then there are floating seeds that can make long voyages by water, and there are sticky seeds and seeds with fuzzy coats so that they get stuck fast to the skins or fur of animals.

But the most successful device of all for the dispersal of seeds was the device of persuading some animal to eat them. This is the reason for fruits. If you like apples, you may carry some of them off a long way from the tree, and when you finally eat them, you will scatter the seeds wherever you happen to be. Other animals do the same.

Some Plants Eat Meat!

Plants seem, too, to be casting longing eyes at the other peculiarities of animals. Some of them, like the familiar sensitive plants of the greenhouses, have developed a considerable power of moving parts of their bodies. The leaves of this plant close up almost instantly if it is touched or shaken. Others covet, apparently, our prerogative of animal food. There are several kinds of plants that catch unwary insects in traps of various sorts and thereafter digest and assimilate the insect bodies.

A very curious one of these plants that we illustrated in the first chapter of this serial is the Venus fly-trap. It possesses both the power of motion and the ability to eat flesh. Its leaves are in two halves like the two covers of a book. If an insect enters between these leaves, they close and the insect is trapped, killed, and digested.

But these small triumphs of the vegetable
(Turn to page 119)

U.S. PATENTS



DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form "EVIDENCE OF CONCEPTION" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish the same before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request. Ask for them, —a post card will do.

PATENTS AND TRADE MARKS
LANCASTER & ALLWINE

2174 Ouray Bldg.
WASHINGTON, D. C.

Originators of forms "Evidence of Conception."

FREE To You

Book of Factory Bargains in Stoves, Ranges, Furnaces, Furniture, Refrigerators, Farm and Home Needs.

Let me send you my new free catalog and show you how to make great savings at wholesale—direct from factory, at money saving prices. Everything guaranteed—set in your home on 30 Days Trial—Don't Risk a Penny Your money back without question or quibble. More than 500,000 satisfied customers.

Easy Terms—Write at Once Just send name and address. A postal will do. W. S. Dewing, "The Stove Man."

Kalamazoo Stove Company
781 Rochester Ave.
Kalamazoo, Mich.

A Kalamazoo Direct to You

Stop Using a Truss

STUART'S PLAPAO-PADS are different from the truss, being mechanico-chemical applicators made self-adhesive purposely to hold the distended muscles securely in place. No straps, buckles or spring attached—cannot slip, so cannot chafe or press against the pubic bone. Thousands have successfully treated themselves at home without hindrance from work—most obstinate cases conquered.

Reduced Fac-Simile Gold Medal Soft as velvet—easy to apply—Inexpensive. Awarded Gold Medal and Grand Prix. Process of recovery is natural, so afterwards no further use for trusses. We prove it by sending Trial of Plapao absolutely FREE. Write name on Coupon and send TODAY!

Plapao Co., 790 Stuart Bldg., St. Louis, Mo.

Name.....
Address.....
Return mail will bring Free Trial Plapao.

HAIR GROWS!

When our Vacuum Cap is used a few minutes daily. Sent on 60 days' FREE trial at our expense. Stops falling hair and dandruff. Science combined with common sense. No drugs or electricity. A postal brings illustrated booklet.

Modern Vacuum Cap Co.
400 Barclay Denver, Colo.

Our Silent Partners

(Continued from page 118)

world over the animal one, we, as animals, can afford to ignore in the light of the havoc that we have worked on plant life for the purpose of agriculture.

Plants that survived the difficulties of escaping from the sea, that fitted themselves successfully into all the climatic vicissitudes of half a billion years, have yielded, at last, to the spirit of man. Man has made over, in large degree, the vegetation of the world. Some plants, such as the forest trees, he has removed bodily from millions of square miles. He has put other plants in their places, merely because he happens to like them better or because he needs something that they produce. An obscure grass, for example, that grew sparsely on the mountains of Lebanon twenty or twenty-five thousand years ago now grows all over the world. It occupied nearly 100,000 square miles of the United States last year. The name of it is wheat.

Man Has Created Some Plants

This is man's doing, not Nature's. Who can say where it will stop? Man, as we said last month, has entered even into the realm of evolution. He has created plants that Nature never thought of. This may be, indeed, the solution of the pressing problem of human food.

Agriculture is not only the most ancient art, it is the art conducted most completely in the antique fashion. Plowing, for example, is still in all essentials, except labor, exactly as it was 6000 years ago. We know very little of the real chemistry of the soil or of the things, chemical and biological, that happen inside the bodies of growing plants. As the scientists learn more of these things, we may be able not only to induce two plants to grow where but one grew before, but to procure from one plant twice or three times or 10 times as much food as it is accustomed to yield. We have already done this for many grains and fruits. Compare, for instance, the wild apple and the cultivated one.

There is the possibility, too, that we may be able to duplicate artificially the process of photosynthesis by which plants use sunlight to make food, an enterprise upon which a committee of distinguished American scientists is now engaged. Success in this would make animals independent of plants for the first time.

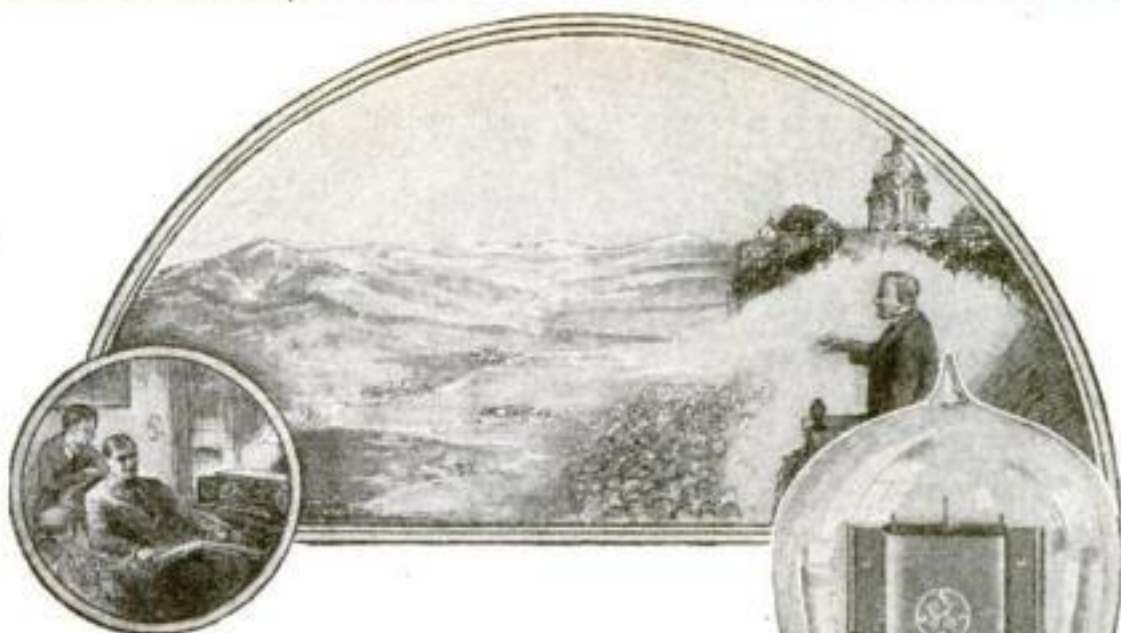
It may happen so; it may not. We cannot foresee. But one thing we may be sure of: the problem of human food must be solved somehow. Life has overcome too many difficulties in the past to be dismayed in the end, by this.

Next month—Matter and Energy— What atoms are and why they are the great potential source of power in the universe—How science is attempting to harness this power.

FOR FURTHER READING

AMONG good books on plant life is "The Living Plant," by W. F. Ganong (Henry Holt and Co., New York, 1913). An excellent short account of the evolution of the plant kingdom is "The Evolution of Plants," by D. H. Scott (Henry Holt and Co., New York, Home University Library, 1911). The scientific student will find an excellent summary of modern researches and many references to further literature in "Plant Physiology," by V. I. Palladin, Second American Edition, edited by B. E. Livingston (P. Blakiston's Son and Co., Philadelphia, 1922).

NOTE: The photograph of the ancient Babylonian tablet, published in the August chapter of the series, should have been credited to the University Museum, University of Pennsylvania.



Carries Great Messages Around the World

THAT statement adequately expresses what is perhaps the greatest influence of radio in developing and bettering human fraternal interest, not only between the people of one community, of one country, of one state, or even a single nation, but between all nations and all peoples of the world.

Be these messages from government leaders—from the heads of the world's greatest educational institutions or from those who stand foremost in the arts of the world—they will serve to bring the human race into closer contact.

In the past ages great orators and writers, famous poets and musicians have swayed the destinies of nations, and have been instrumental in the rise and downfall of mighty empires.

In the future these same influences of similar great minds will, through radio, create a better understanding and a greater fraternal spirit between the people of the nations.

It is the vacuum tube that has made possible this broad and far-reaching application of radio telephony, and that plays the most important part in the operation of your receiving set.

Cunningham Vacuum Tubes, standard for all makes of receiving sets—built by one of the world's largest manufacturers with unlimited resources—are the product of years of manufacturing experience and the creative genius of the engineers of that great scientific organization, the Research Laboratory of the General Electric Company.

Cunningham Radio Tubes

C-301A—6 Volts 1/4 amp. Amplifier.....	\$6.50
C-299—3 Volts .06 amp. Dry Battery Det. & Amp.....	6.50
C-300—6 Volts Gas Content Detector.....	5.00
C-11—1.1 Volts .25 amp. Dry Battery Det. and Amp. Special Base.....	6.50
C-12—Similar to C-11 with Standard Base	6.50

Home Office
248 First Street
San Francisco, Calif.

Patent Notice: Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08, and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.

E. J. Cunningham Inc.

154 West Lake Street
Chicago, Illinois

30 Church Street
New York City, N. Y.

CUNNINGHAM
National
Tube Week

September 24 to
October 1, 1923

\$5000 in Cash Prizes
to Radio Dealers

Easy Now to Keep Your WINDSHIELD CLEAR in Rain, Fog or Storms

A mysterious new liquid, which can be put on windshield in 30 seconds and gives a lasting transparent surface now enables every motorist to see clearly through the glass, regardless of weather. **FREE.** Simply send name for absolutely free sample. Alexander Laboratories, Dept. 6, Kansas City, Mo.

HOME STUDY

Become More Efficient

through courses in Mathematics, History, English, Chemistry, Psychology, Education, Business and 35 other subjects which the University gives by mail. They command credit toward a Bachelor degree and may be begun at any time.

The University of Chicago

25, 'th Hall

Chicago, Ill.



Diamonds Here at 60% of Market Price

The Buys of a Lifetime

Never in three-quarters of a century in the diamond business, have we offered such bargains as we do now compared with prevailing prices. Diamonds right now at rock-bottom even in regular market. Yet ours are but 60% of market prices. The opportunity of a lifetime. Buy now—the trend is already upwards, but, our diamond prices are based on unpaid loan diamonds left on our hands for a fraction of their real value.

Why Pay Full Prices Costs Nothing to See

This diamond banking house, 3/4 century old, rated more than \$1,000,000.00, takes this way of turning into cash the diamonds on which money was loaned and not repaid. Also many bargain gems from other sources. See these bargains as the wisest buyers do.

Send for Latest Bargain List

Every gem fully and minutely described. Radically different from a catalog. Any gem sent you on approval without slightest obligation to buy. Write now. The very stone you wish may be in this present list at a price that will amaze you. Send this coupon now.

JOE DE ROY & SONS
Only Opposite Post Office
4713 DeRoy Bldg., Pittsburgh, Pa.

References by permission: Bank of Pittsburgh—N. A. Marine National Bank—Union Trust Co. Pittsburgh, Pa. Your bank can look us up in mercantile agencies.

JOE DE ROY & SONS
4713 De Roy Bldg., Pittsburgh, Pa.
Gentlemen: Please send me absolutely free and prepaid, your new bargain list of diamonds, watches and other jewelry. It is distinctly understood that I assume no obligation of any kind.

Name _____
Address _____

As Low As \$60 a Carat for Diamonds

Wreck survivors tell how tobacco kept them going

When food and water gave out
on third day, they smoked
until rescued

Perhaps they were only pirates of the sea. Nevertheless, they were very much human beings when they found themselves miles out to sea adrift in an open boat.

With two days' supply of food and water, they confidently expected to be rescued in plenty of time. But when the third day passed and no friendly sail appeared on the horizon, it began to look like a case for Davy Jones's locker.

One of the victims, crazy with thirst, suggested that they divide a bottle of iodine and end the agony quickly.

"The tobacco hasn't given out yet," said another. "Let's stick it out a while longer." And they did.

Late in the afternoon of the fifth day a tramp schooner saw their distress signals and came valiantly to the rescue.

"The only thing that kept us going at all was tobacco," one of the survivors admitted when he was safely deposited on dry land again.

Pipes filled with Edgeworth probably have no more soothing effect than pipes filled with other tobaccos, but most Edgeworth smokers feel that they need Edgeworth to get complete pipe satisfaction.

If you have never smoked Edgeworth, send your name and address on a postcard to Larus & Brother Company. They will be glad to send you free samples—generous helpings both of Edgeworth Plug Slice and Ready-Rubbed.

Smoke a few pipefuls and judge for yourself whether or not you wish to become a permanent member of the Edgeworth Club.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Ready-Rubbed are packed in small, pocket-size packages, in handsome humidor holding a pound, and also in several handy in-between sizes.

For the free samples, kindly address Larus & Brother Company, 59 South 21st Street, Richmond, Va. If you will also include on your postcard the name and address of your regular tobacco dealer, your courtesy will be appreciated.

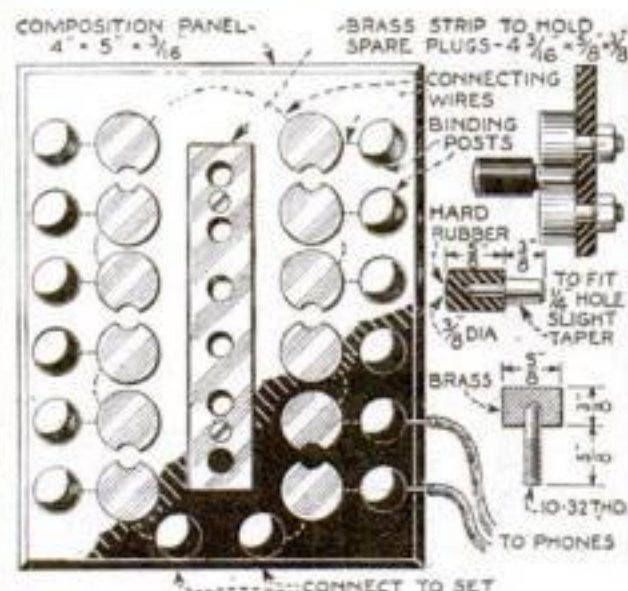
To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.



Plug Switchblock Gives Easy Control of Radiophones

THE radio fan who prizes neat and unusually efficient apparatus will find the switchboard illustrated an excellent means for controlling the connections of his loudspeaker and telephone headsets. Five pairs of phones and a loudspeaker can be plugged in or out at will without changing any connections.

The base is a $\frac{3}{16}$ by 4 by 5 in. composition panel. The connectors are 12 pieces of $\frac{5}{8}$ -in. brass rod. The head of each is $\frac{5}{8}$ in. in diameter and $\frac{3}{8}$ in. deep, with a threaded stud or a separate stud provided, as shown, from a length of 10/32 threaded rod. It is just as well to mount these connectors first on a wooden templet the same size as the composition panel. Place the connectors so that there will be $\frac{1}{16}$ -in. clearance between the units of each pair, and $\frac{1}{8}$ or $\frac{1}{4}$



How the switchblock is laid out, and the plugs and connectors are made

in. between the pairs. When the studs have been locked tight with nuts, drill $\frac{1}{4}$ -in. holes between and through the heads of each pair, as shown. A piece of brass $\frac{3}{8}$ by $\frac{5}{8}$ by $4\frac{1}{8}$ in. should also be drilled with the same size holes to hold the plugs when not in use.

The plugs should next be turned, as indicated, to be a snug yet not too tight a fit in the $\frac{1}{4}$ -in. holes. A slight taper is desirable. Hard rubber handles about $\frac{3}{8}$ -in. in diameter and $\frac{5}{8}$ in. deep should be prepared for the plugs, but not fitted to them until they have been nickel plated and polished at a plater's or jeweler's.

While this is being done, use the wooden templet for marking and drilling the composition panel. Drill holes for the binding posts, bevel the edges, and give a satin finish with fine emery paper. The nickel-plated parts are then attached and the hard rubber handles fitted to the plugs.

The connections are made at the back, as shown by the dotted line, and the panel can be fastened to a hardwood block, recessed to take the projecting nuts and wires. The edges of the block should be polished.

In use, the loudspeaker and telephone are connected with the various binding posts and the receiving set is connected with the terminal binding posts. To plug in the loudspeaker or any particular pair of phones, simply remove the plug from between the corresponding connectors and place it in the holder.—LESLIE GREENSLADE, Hamilton, Ontario, Can.

AN EASILY made revive for keeping waxed floors in good condition is composed of turpentine, vinegar, and sweet oil in equal parts. If applied once a week, it will keep the floors in good condition.

MEN WANTED

to call on garages, stores, factories, schools, hotels, homes, auto owners and demonstrate and take orders for new

SUPER FYR-FYTER

Approved by Underwriters, makes spectacular demonstration. Sells easily.

Blake made \$59.60 first week. DePries has averaged \$7,000 per year for last 3 years. We can train you, without cost, so you can do as well or better. No experience necessary. Write at once for free details showing how you can earn \$2,000 to \$10,000 a year.

THE FYR-FYTER CO.
1014 Fyr-Fyter Bldg., Dayton, O.

NEW CORD

Price—Lowest Ever

GREAT PRICE CUT ON GEM CORDS

the tire that gives 10,000 miles of satisfactory service. Cut your tire costs by these excellent GEM CORD TIRES at low prices. Best tire ever seen. Another Gem Cord half price for any tire not satisfactory.

SEND NO MONEY

ALL GEM CORDS shipped C.O.D. EXAMINE TIRE. If not the best buy you ever made, return the tire and get your money back.

Size	Cords	Tubes
30x3	\$6.15	\$1.05
30x3 1/2	6.75	1.25
32x3 1/2	8.45	1.55
31x4	9.75	1.65
32x4	10.25	1.75
33x4	10.75	1.90
34x4	11.25	1.95
32x4 1/2	13.45	2.00
33x4 1/2	13.95	2.10
34x4 1/2	14.50	2.25
35x4 1/2	14.95	2.50
36x4 1/2	15.25	2.50
33x5	16.00	2.75
35x5	17.00	3.00

ORDER NOW—5% discount for cash with order.

GEM RUDDER COMPANY
Dept. 441 1315 S. Oakley Blvd., CHICAGO, ILL.

Make \$75.00 a Week and up

Make \$75.00 a week and up, selling our fine made-to-measure, all-wool suits, direct to wearer. Biggest values—positively sell on sight. Biggest commissions paid in advance. We attend to delivery and collections. 6x9 swatch samples—over 100 styles all one price—furnished FREE. Part or full time men write at once.

W. Z. Gibson, Inc., 161 W. Harrison St., Dept. X-15, Chicago

You Can Save \$35.00

Recover it yourself. Custom tailor made to fit all makes and models. Roof and quarters sewed together, with rear fasteners, welts and tacks, complete. Anybody can put it on. Give name, year, model number of your car. Catalog FREE. Agents wanted.

LIBERTY TOP & TIRE CO Dept. E8 Cincinnati, O.

SEND FOR THE INTERNATIONAL CATALOG

Our net price list. Full line of auto bodies and accessories for Ford. Wholesale Prices. Save big money on bodies by buying Direct from Factory.

FOR FORD—Prices from \$27.85 up. Factory to consumer direct—Pay only One Profit

INTERNATIONAL BODY WORKS, 914 W. Ohio St., Dept. 8, Chicago, Ill.

Ingenious Gun Rest Simplifies Testing Rifle Sights

EVERY sportsman occasionally wishes to test the accuracy of his rifle sights. In doing this easily and quickly, the gun rest illustrated is a distinct aid. It reduces the "human element" to a minimum, and, by using it for several shots, the grouping on the target will show up any marked deviation to right or left, or high or low.

The standard for the rest is a well-built sawhorse, the legs being mortised into the

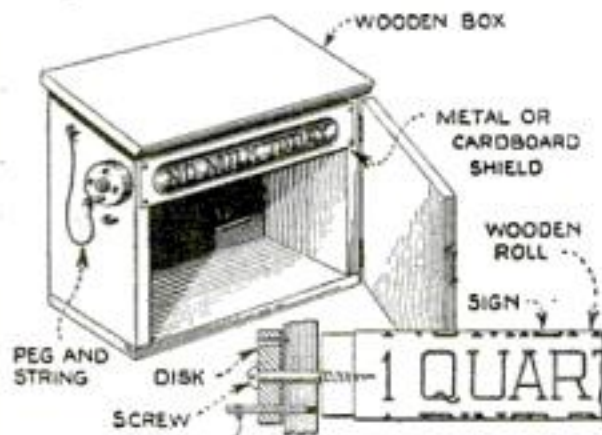


4 by 4 in. saddle at an angle. On the forward end of the horse an upright is dovetailed, so that it will slide as required, and at the same time be quite rigid. The upper end of the upright is notched to receive the gun barrel.

Just back of this upright an adjustable beam is hinged and into it is dovetailed a second upright, also notched to support the gun. Near the end of the horse is an adjusting screw for raising or lowering the hinged beam when sighting the rifle on the bull's eye.—LEROY W. HUTCHINS.

Changeable "Note" for Milkman

THE addition of a revolving indicator to a milk-bottle box makes it unnecessary to write notes to the milkman when extra quantities of milk and cream are desired. The wooden roll, made from an old curtain pole, is mounted so as to revolve easily near the top of the box. A wooden disk, about $\frac{3}{8}$ in. thick, cut from the same curtain pole, is fastened tightly to one of the pivot screws on the outside of the box.



A revolving indicator takes the place of scribbled orders.

Several holes are drilled through this disk, and one hole for indexing is drilled into the side of the box, so that a peg may be used to fasten the disk in any of its positions.

The roll itself is covered with a sheet of white paper on which the desired orders are lettered with waterproof drawing ink, one order corresponding to each index hole. A mat cut from galvanized iron, tin, or even cardboard is fastened to the box to serve as a frame for the roll.—KARL L. MARTIN.

Your "Greater Self" never Sleeps



DID you ever feel that you were being directed, at a crucial moment, in an important task, or when making a momentous decision, by some intelligence and power vastly greater than yourself?

Did your heart ever grow sick of the daily grind and the dull drab prospect of all the days and years ahead? And then did you experience an inspiring flash of thought, amounting almost to whispered words, that a higher, nobler and happier life was possible to you—that it was within your power to make your life anything you wanted it to be?

If either of these experiences ever came to you, did you wonder whence the inspiration came? It was your Greater Self whispering to you, and urging you on to become and achieve the things you wanted to become and achieve. You actually have a Greater Self. It occupies four-fifths of your brain. It never sleeps. It built your body from the beginning, and still sustains, repairs and renews it. It is your God-Mind. It is timeless, and changeless,

and deathless, and abundantly able to give you every desire of your heart.

Although I am actively engaged in high judicial work, I have found time to prepare a personal manuscript message entitled "Realization," which has introduced a great many men and women to their Greater Selves, and since that introduction they have healed themselves of stubborn diseases, come into possession of the things they desired, succeeded abundantly in business and professional life, attained love and happiness, and come into a calm peacefulness of mind which passes understanding. I will be glad to send you a copy of "REALIZATION" fully post-paid and

Absolutely Free of Charge

if you will merely fill out and mail to me the coupon at the bottom of this column.

DANIEL A. SIMMONS
JACKSONVILLE, FLORIDA

DANIEL A. SIMMONS,
Law Exchange Building,
Jacksonville, Fla.

I accept your offer to send me free and postpaid a copy of your personal manuscript entitled "Realization," with the understanding that I thus incur no obligation of any kind whatsoever.

Name.....
Street or RFD.....
City.....State.....P. S. 10-23

New High Paid Profession of Scientific Barber

Moler System Graduates Earn Big Money

Learn Near Home at Moler College

You have right close to you a fine equipped and directed Moler-College. Pick out nearest one and write or stop in.

157 Third Ave.	New York, N. Y.
105 S. Wells St.	Chicago, Ill.
810 N. 6th St.	St. Louis, Mo.
544 Main St.	Kansas City, Mo.
341 W. 5th St.	Cincinnati, Ohio
215 Huron Rd.	Cleveland, Ohio
1045 C. St. Ave.	Detroit, Mich.
1229 17th St.	Denver, Colo.
110 S. 14th St.	Omaha, Neb.
513 E. Water St.	Milwaukee, Wis.
1095 Canal St.	New Orleans, La.
192 Marietta St.	Atlanta, Ga.
80 N. 2nd St.	Memphis, Tenn.
910 Main St.	Dallas, Texas
712 Franklin Ave.	Houston, Texas
227 W. Commerce St.	San Antonio, Texas
198 Queen St. E.	Toronto, Ont., Can.

Mail Coupon for full information on this high paid profession with Free Booklet C

Many Moler System graduates own their own fine businesses and earn from Five to Ten thousand dollars a year. Modern, scientific barbering as taught by the Moler System gives you a profession that enables you to earn from Fifty to One Hundred Dollars a week within a few months of the time you start to learn.

Be Your Own Boss. You can own your shop and be independent with a very good income. We will equip your place for you on easy terms.

The Moler System has shown thousands of men a sure, easy to learn way to make good money in a clean, carefree business.

Hotels, Office Buildings and individual shops call for well dressed, well paid men to run them. The Moler System teaches you the latest scientific

methods including the electric hair-cutter, mechanical massage, scientific treatments and girls' hair bobbing. There are special courses also on scalp and skin treatments.

Learn About This New high paid business. We will tell you how to earn while you learn and show you how to get the best city jobs or equip your own shop. Call or write today for our free booklet C at branch nearest you as listed here. Use the coupon below.

Moler System of College

(Write Nearest Branch)
Please send without obligation your Free Booklet C and full information.

Name.....
Address.....

Special to Moler Post Graduates

Our Post Graduates may become part of our System after completing, use our name, and benefit by our National Advertising educating the public to Moler Post Graduate Service.

Moler System of Colleges

33 Branches

Address nearest in above list



An Easy Way to Learn PHARMACY AT HOME

Graduate pharmacists are always in demand. The work is interesting and pleasant and salaries are good. Many young men open drug stores of their own and become independent.

There's an easy way to learn pharmacy right in your own home in spare time, without losing a day or a dollar from your present work.

The International Correspondence Schools course in Pharmacy supplies the knowledge which it will be necessary for you to have in order that you may pass your State Board Examination.

Just mark and mail the coupon printed below to the International Correspondence Schools, Box 7658-C, Scranton, Pa., and full particulars about the Pharmacy Course or any other work of your choice will come speeding to you by return mail.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS Box 7658-C, Scranton, Penna.

Without cost or obligation on my part, please send me full particulars about the subject before which I have marked an X in the list below:

TECHNICAL AND INDUSTRIAL COURSES

- | | |
|--|--|
| <input type="checkbox"/> PHARMACY | <input type="checkbox"/> Civil Engineer |
| <input type="checkbox"/> Chemistry | <input type="checkbox"/> Surveying and Mapping |
| <input type="checkbox"/> Automobile Work | <input type="checkbox"/> Mine Foreman or Engineer |
| <input type="checkbox"/> Agriculture and Poultry | <input type="checkbox"/> Steam Engineering |
| <input type="checkbox"/> Mathematics | <input type="checkbox"/> Gas Engine Operating |
| <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Airplane Engines <input type="checkbox"/> Radio |
| <input type="checkbox"/> Electrician | <input type="checkbox"/> Architect |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Contractor and Builder |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Architectural Draftsman |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Concrete Builder |
| <input type="checkbox"/> Railroad Positions | <input type="checkbox"/> Structural Engineer |

BUSINESS TRAINING COURSES

- | | |
|---|---|
| <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Business Management |
| <input type="checkbox"/> Advertising | <input type="checkbox"/> Industrial Management |
| <input type="checkbox"/> Better Letters | <input type="checkbox"/> Personnel Organization |
| <input type="checkbox"/> Foreign Trade | <input type="checkbox"/> Traffic Management |
| <input type="checkbox"/> Stenography and Typing | <input type="checkbox"/> Business Law |
| <input type="checkbox"/> Business English | <input type="checkbox"/> Banking and Banking Law |
| <input type="checkbox"/> Civil Service | <input type="checkbox"/> Accountancy (Including C.P.A.) |
| <input type="checkbox"/> Railway Mail Clerk | <input type="checkbox"/> Nicholson Cost Accounting |
| <input type="checkbox"/> Common School Subjects | <input type="checkbox"/> Bookkeeping |
| <input type="checkbox"/> High School Subjects | <input type="checkbox"/> Private Secretary |
| <input type="checkbox"/> Illustrating | <input type="checkbox"/> Business Spanish <input type="checkbox"/> French |

Name.....

Street Address.....

City..... State.....

Occupation.....

Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada.

30X3½ CORD NEW \$2.00 TIRE PRICE

GUARANTEED 8 MONTHS
AT HALF PRICE

These are Goodrich, Goodyear, Firestone, Fisk and other best known standard make tires. All slightly used, but readily give our customers thousands of miles of splendid service.

LOWEST TIRE PRICES IN AMERICA

Tires	New Tubes	Tires	New Tubes
30x3 \$1.90	.90	32x4 3/4 \$3.75	\$1.65
30x3 1/2 2.00	.90	33x4 3/4 3.75	1.65
32x3 1/2 2.50	.90	34x4 3/4 4.00	1.65
31x4 2.75	.90	35x4 3/4 4.25	1.65
32x4 3.00	1.40	36x4 3/4 4.25	1.65
33x4 3.25	1.40	35x5 4.25	1.95
34x4 3.50	1.40	37x5 4.25	1.95

SEND ONLY \$1.00 for each tire shipped. Balance C.O.D. Express shipments sent section unwrapped for inspection. Tires guaranteed eight months. Another tire given at half price for any not perfectly satisfactory. Dealers and Agents wanted everywhere. WRITE—RUSH ORDERS.

ROSE TIRE CORPORATION
Dept. K-239 1526 S. WABASH AVE., CHICAGO, ILL.



Home Workshop Chemistry

*Simple Formulas that
Will Save Time
and Money*

CEMENTS and glues can be used for the most diverse purposes in the home workshop. Some are water resistant, others fireproof, and others useful for joining either similar or dissimilar materials.

An effective cement for many substances can easily be made by soaking one part of glue in an equal quantity of water. The glue is removed before it has lost its primitive form, and the swollen mass is then dissolved in one part of linseed oil with the aid of heat until a jelly is formed. This joins wood tightly and is practically waterproof.

Finding that the continual reheating of glue is often troublesome, especially if small quantities only are required, I make a simple liquid glue. Although not as strong when dry as a glue especially prepared for a given piece of work, it serves the purpose about as well, especially for the small jobs that constantly require attention in every household.

One part of sugar is dissolved in three parts of water, and for each tablespoon of sugar used, 1/4 teaspoon of burnt or slaked lime is added. The solution is then slightly heated, not boiled, and, when cold, decanted from the sediment, which is thrown away. Dry carpenter's glue is dissolved in the liquid by putting in a few small pieces first and adding others until the glue has a syrupy consistency when cold. Should it become too thick, a little more of the sugar and lime water is added.

This is a fine glue for ordinary small jobs and suitable even for delicate inlays if gelatin is substituted for the carpenter's glue. It then becomes a transparent, colorless mucilage.

A glue that has received much attention lately, because it is widely used in aircraft work and automobile body construction, although a glue that even the ancient Egyptians used for their remarkably enduring cabinet work, consists largely of casein. Casein, which is nothing more than the curd of milk, can be obtained by slightly warming fresh milk to which a little acetic acid has been added. The precipitate is filtered through a cloth and washed. One part curds to four parts of water are stirred together until no lumps remain; a little ammonia is then added and the glue is placed in a pan of hot water and thoroughly stirred. It can be used cold like any mucilage.

A cement of glycerin and litharge is so hard that it can be removed only by being chopped out with a chisel. A pound of finely ground dry litharge is thoroughly stirred with 1 1/2 oz. glycerin, or in similar proportions. Use as soon as mixed, first rubbing a little viscous glycerin over the surface of the materials to be joined. The job must be finished within 15 minutes, as the mixture solidifies after 20 or 30 minutes.—ERNEST BADE, Ph.D.



Mixing glycerin-litharge cement

Ear Caps Cover the Ears

Stromberg-Carlson Radio Head Sets

are equipped with ear caps that cover the ears—excluding outside noises. This means that the user can enjoy listening without the irritation of being disturbed by every little noise in the room. Stromberg-Carlson Head Sets are preferred for other reasons:—

- The receivers are layer wound and layer insulated—to stand up under high plate voltages.
- The adjustment rod telescopes and therefore does not catch the ladies' hair.
- The receivers are balanced as to volume—both ears get the message.
- Order Stromberg-Carlson apparatus through your electrical dealer or write for circular No. 1029-PS.

Stromberg-Carlson Telephone Mfg. Co.
Rochester, N. Y.

Warren Radio Loop,
Cut Away to Show
Construction.

WARREN RADIO LOOP

Adds these Advantages to Your Set

Sharper Tuning
One tuning adjustment—no others needed.

Directional
Receives signals strongest Selective

Picks out just the station you want to hear.

Portable
Small, light, compact. Ideal for portable and mobile sets.

Wider Range of Frequencies
On single coil. Small re-radiative effect. Fine for regenerative circuit.

A TYPE FOR EVERY SET

Type-A-737 (300-700 meters) 6 inches square—non-directional \$10
Type-A-7236 (110-1000 meters) 6 inches square—non-directional \$12
Type-B-2537 (300-700 meters) 18 inches square—directional \$20
Type-BL-2520 (300-18,000 meters) with honeycomb coil mounting, 18 inches square—directional \$25

Send for Bulletin U-102

V-DE-CO RADIO MFG. CO. Dept. O, Ashbury Park, N. J.

"LIGHTING FIXTURES"

Ready to hang.
Direct from manufacturers.
Completely wired including glassware.

Send for Catalogue No. 24 and
Dealers' proposition

ERIE FIXTURE SUPPLY CO.
Desk A, Erie, Pa.

WE TEACH COMMERCIAL ART

Meyer Both Company, the largest Commercial Art Organization in the World, offers you an unusual opportunity for practical training, based upon twenty-three years of success. This nationally known organization each year produces and sells to advertisers over 15,000 commercial drawings. Meyer Both instruction is the difference between successful fact and experimental theory. This well paid profession equally open to men and women. Home study instruction.

Get Facts Before You Enroll in Any School

Ask the Advertising Manager of the leading newspapers in your city, anywhere in the United States, Canada, England or Australia about the Meyer Both Company—let them tell you about us. Write for our illustrated book telling about the success of our students—for one-half the cost of mailing—four cents in stamps.

MEYER BOTH COMPANY

Department of Art Instruction

Michigan Ave. at 28th St., Dept. 35 CHICAGO, ILL.

Note—To Art and Engraving Firms: Secure practical artists among our graduates. Write us.

You, Too, Can Play the HAWAIIAN GUITAR Just as the Natives Do—

After Your FIRST LESSON
You Will Play "ALOHA".
We Guarantee That—

Our method is so simple, interesting and appealing that you begin in your first lesson to learn the famous Hawaiian Folk Song "ALOHA". Think how happy you will be when you surprise your friends by playing the fascinating Hawaiian Guitar just as the natives do!

Only Four Motions—
and You Master Them Quickly!

In a few minutes you acquire the four motions necessary to play any piece—after that a short period of practice and you will have mastered this weirdly sweet music. Complete course of 51 lessons includes 200 beautiful Hawaiian Guitar, necessary picks, steel bar, etc., no extras.

No Previous Musical Knowledge Necessary
If you never read a musical note in your life—if you haven't even the slightest knowledge of music, we can quickly and positively teach you to play this wonderfully popular instrument. Don't be just a "listener" when you can easily be the center of interest among your friends.

Just Mail a Post Card for Details
of our remarkable FREE Hawaiian Guitar Offer—
simply write: "I am interested"—but do it today!

Address
First Hawaiian Conservatory
of Music, Inc.

Special arrange-
ments for lessons if
you have your own
Hawaiian Guitar.
Desk 48 230 N. 4th Ave.
(Worworth Bldg.)
New York City

FREE
A Beautiful
Hawaiian
Guitar

ACE TYPE U

Formerly called
Crosley Model V

The low cost of this set together with its simplicity makes it the preference of thousands of radio enthusiasts. A long range receiver. Stations from coast to coast heard distinctly. An ace two-step amplifier in connection with this set at \$20 makes use of loud speaker practical. Has Crosley Multitast, which permits use of any make tube. Write for your copy of "Simplicity of Radio"—its FREE. Ask your dealer to show you this set.

THE PRECISION EQUIPMENT COMPANY

POWELL CROSLY, JR., President
1917 Vandalia Avenue Cincinnati, Ohio

FREE RADIO BOOK

An easily understood explanation of Radio written by Powell Crosley, Jr., President of Crosley Mfg. Co., Cincinnati, and The Precision Equipment Co., Cincinnati.

Write today for this Booklet.
CROSLY MANUFACTURING CO.
1917 Alfred St. Cincinnati, O.

\$50 to \$100 a Week

—and much more is being made by many of our 4000 Paul men demonstrating and selling—

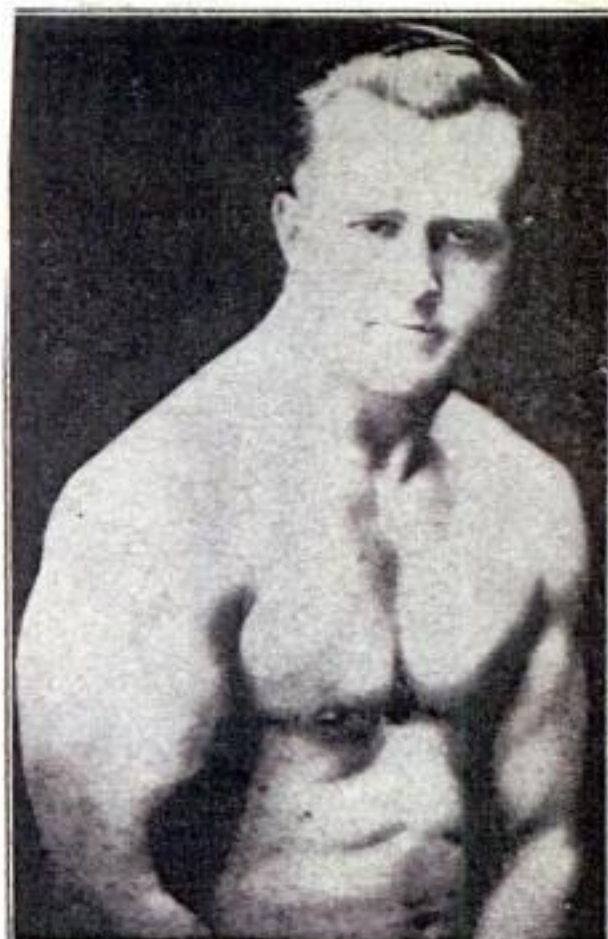
AIR-GAGE Inner Tubes

—greatest improvement ever made. Air Gauge in valve stem of every tube shows pressure at a glance. Build a profitable and permanent business of your own. Experience not necessary. We teach you how to sell and give exclusive territory. Free book explains all.
PAUL RUBBER CO. Dept. 54, Salisbury, N. C.

11 IT .
fan motor grinder illustrated, use a piece of brass or other pipe, about 1½ in. long and of a diameter to fit snugly over the motor shaft. Next obtain a machine screw that will fit inside the pipe and cut off 1½ in. Slide the cut end halfway inside the pipe and solder it securely, being sure that it is properly centered. Then solder a large iron or brass washer against the end of the pipe to serve as a flange, and make a heavy fillet of solder to reinforce the joint. Fasten the pipe to the shaft with a setscrew and hold the wheel on with locknuts.—J. G. PRATT.



Using a fan motor
as a grinder



Earle E. Liederman
as he is today

Pills Never Made Muscles Wishing Never Brought Strength

NO one can paste muscles onto your arms and shoulders. If you wish a strong, healthy body, you must work for it. And if you don't have one, you are doomed to a life of misery. Modern science has taught us that we must keep our bodies physically fit or our mental powers will soon exhaust themselves. That is why the successful business man resorts to golf and other active pastimes.

Examine Yourself

Do you have the strong, robust body which keeps you fit at all times to tackle the daily tasks confronting you—always looking for bigger things to do? Do you jump out of bed in the morning full of pep; with a keen appetite and a longing to enter the day's activities? Do you finish your daily tasks still thrilling with pep and vitality? Or do you arise only half awake and go through a languid day?

PEP UP!

Don't let it get you, fellows. Come on out of that shell and make a real *he* man of yourself. Build out those skinny arms and that flat chest. Let me put some real pep in your old backbone and put an armor plate of muscle on you that will make you actually thrill with ambition. I can do it. I guarantee to do it. I will put one full inch on your arm in just 30 days and from then on, just watch 'em grow. This is no idle boast. It's the real works. A genuine guarantee. Come on now. Get on the job and make me prove it.

Send for My New Book "MUSCULAR DEVELOPMENT" It Is Free

This will show you some of my remarkable achievements. Sixty-four pages with dozens and dozens of full page photographs of myself and a number of my pupils. Read what they say about my system. Don't take my word for it. This book will be an impetus, an inspiration to every red-blooded man. All I ask is the price of wrapping and postage—10 cents. Remember this does not obligate you in any way, so don't delay one minute. This may be the turning point in your life. Tear off the coupon and mail at once—now, while it is on your mind.

EARLE E. LIEDERMAN

Dept. 1310, 305 BROADWAY, NEW YORK CITY

EARLE E. LIEDERMAN
Dept. 1310, 305 Broadway, New York City

Dear Sir:—I enclose herewith 10 cents for which you are to send me without obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

Name.....

Address.....

City..... State.....

Strength!



THIS proves how well Ole Evinrude has protected the Elto light twin against the greatest cause of wear and breakage—the distortion and disalignment of the drive shaft due to striking under-water obstacles. In addition to safety-tilting, the Elto is protected with full floating type drive shaft construction—making shaft distortion or disalignment absolutely impossible. This exclusive feature, together with the fact that the Elto has double the bearing area of any other lightweight outboard motor, and that its crank and driveshafts are case hardened, finely ground and heavily plated, beyond all question gives the Elto the longest, trouble-free service life.

Speed!



RECENT British Motor Boat Club International Regatta on the Thames—one Elto entered against European and American outboard motors of all weights and horsepower, *Elto wins first place—and prize for covering course in fastest time.*

Pacific Coast International Regatta—three mile course in rough open sea. Elto wins *first and second prizes* against competitive motors of all weights and power.

No obscure races these! Both important International events that prove beyond question the supreme speed of the Elto!

The Elto is the most powerful lightweight motor, the lightest motor per horsepower. It starts as easily as striking a match because it has a big hot spark independent of cranking speed and for the same reason it can be slowed down to real fish-getting trolling speed. Rudder steering. No dangerous pivot turning! Tiller rope control from any part of boat. No shaky, vibrating steering handle. The only 3 H.P. light weight motor—a full extra horsepower over other lightweight motors, the needed H. P. for substantial boats—to buck wind, waves, currents and tides or sudden storms.

Send for catalog—an enlightening booklet—not merely a picture book.



Dealers and Demonstrating Agents wanted. Exclusive Territory. Write for Special Offer.

Elto Outboard Motor Co.
Dept. W.
Manufacturers Home Building
Milwaukee, Wis.

3 H.P. Fast
Light Twin

Elto

Dollars for Ideas

IN KEEPING your home shipshape, you often hit upon ingenious, time-saving, labor-saving and money-saving ideas.

If you will describe, in not more than 200 words, each of your ingenious keeping - the - home - shipshape methods, we will pay \$2 for every one published. Include a pencil sketch or photograph to illustrate the idea, if possible, and address your letter to the Home Workshop Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York.

Monthly



We maintain the same high quality material and workmanship found on the most expensive batteries and still are able to allow our remarkably low sale price by greatly reducing our overhead and sale costs.

"WORLDS OF PERFORMANCE"

Thousands of users enjoy the dependable qualities of our battery. World battery owners "tell their friends." This is our best proof of performance.

READ SPECIAL OFFER BELOW

Automobile Prices		Radio Prices	
6 Volt, 11 Plate - \$13.25		2 Volt. - \$5.00	
Ford, Chev., Mitchell, Hup., Grant, Elgin, Velle, Saxon.		(For W.D. 11 Tube)	
6 Volt, 13 Plate - \$15.25		6 volt. 60 Amp. \$10.00	
Overland, Buick, Reo, Paige, Hudson, Nash, Stude., Dorr.		6 " 80 " 12.50	
12 Volt, 7 Plate - \$18.50		6 " 100 " 14.50	
Maxwell, Dodge, Regal, Frank, Briccoe and Crow-Elkhart.		6 " 120 " 16.00	
Give year and model of car			

SEND NO MONEY

We ship C. O. D. subject to inspection, or will allow 5% discount for cash with order. Shipment made same day order is received. Save 50% on your next battery and get better service and longer life. Our written 2-year guarantee Order today—now.

SPECIAL OFFER


Just clip this ad, mail in with order, and we will include one Eveready "B" Battery, or one Auto Spot Light free of charge. Accept this liberal offer now before it is withdrawn.

WORLD BATTERY CO.

Dept. 7

1219 So. Wabash Ave.

Chicago, Ill.



Free!

Get My New Book of Factory Prices

FURNACES, STOVES and RANGES

Let me show you how to save \$40 to \$200 on the finest quality pipe or pipeless furnace ever made. Sold direct to you at **Factory prices—\$59.95 and up**. Easy to install. Easy payments. Quick shipments. Safe delivery. 360 days approval test. More than 500,000 pleased customers. Mail a postal or letter today—get my new Factory-to-Family Bargain Book—FREE.

W. S. Dewing
"The Direct-to-You Man"
KALAMAZOO STOVE COMPANY
781 W. Rochester Ave.
Kalamazoo, Michigan

A Kalamazoo Direct to You

TYPEWRITER Prices Smashed!

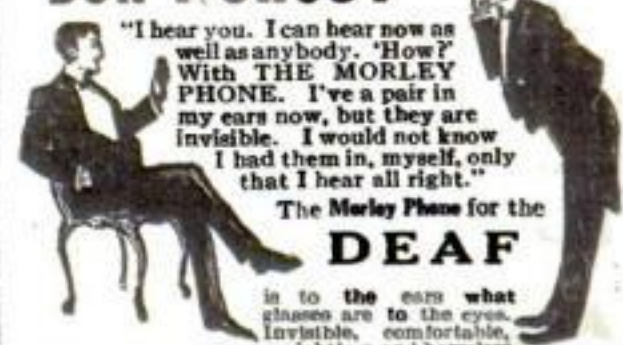
ONLY \$200 DOWN and its yours!



Your choice of the World's best typewriters—Underwood, Remington, Oliver—full size, late model, completely rebuilt and refinished brand new. Prices smashed to almost half. Just send your name and address and we will mail you our complete FREE CATALOG prepaid, fully describing and showing actual photographs of each machine in full colors. We also send every detail of our direct-to-you small-payment plan. Write NOW to save at least one-half. No obligation on your part whatever. **ACT QUICK!**

INTERNATIONAL TYPEWRITER EXCHANGE
177 N. State Street Dept. 10-49 Chicago, Illinois

"DON'T SHOUT"



The Morley Phone for the **DEAF**

is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Over one hundred thousand sold. Write for booklet and testimonials. **THE MORLEY CO., Dept. 197, 26 South 15th Street, Philadelphia**

This One



WTG5-GW4-GW2Q

21 JEWEL Santa Fe Special



No Money Down

While other watch dealers are raising their prices, asking you for larger monthly payments, and making payment terms harder for you to meet, we are offering you our new model Santa Fe Special, no advance in price, no money down, easier terms and smaller monthly payments. WE realize the war is over and in order to double our business we MUST give you pre war inducements, better prices, easier terms and smaller payments.

LOOK

Adjusted to Positions
Adjusted to Temperature
Adjusted to Isochronism
Adjusted to the Second
Thin Model. All Sizes

Without one penny of advance payment let us place in your hands to see, to examine, to inspect, to admire, to approve, a real masterpiece in watch creation. A Watch which passes the most rigid inspection and measures up to the exacting requirements of the great Santa Fe Railway System, and other great American trunk lines.

Page 12 of our Watch Book is of
Special Interest to You

Ask for our Watch Book free—then select the Watch you would like to see, either the famous Santa Fe Special or the 6 position Bunn Special, and let us explain our easy payment plan and send the watch express prepaid for you to examine. No Money Down. Remember—No money down—easy payments buys a master timepiece—a 21 Jewel guaranteed for a lifetime at about half the price you pay for a similar watch of other makes. No money down—a wonder offer.

SANTA FE WATCH COMPANY
Dept. A80 Thomas Bldg., Topeka, Kansas
(Home of the Great Santa Fe Railway)

A Letter, Post Card or this Coupon Will Bring
My Beautiful Free Watch Book

SANTA FE WATCH CO.
Dept. A80 Thomas Bldg., Topeka, Kansas

Please send me your New Watch Book with the understanding that this request does not obligate me in any way.

Name.....
Address..... State.....

BIG FREE BOOK BEAUTIFUL FURNISHINGS

The very things you need. Latest styles. Factory-to-Family prices. Save big money. Furnish a room or whole home. As little as \$3 down; a year or more to pay. Also Pianos, Players, Phonographs. Cut out this adv.—write TODAY, for new "Larkin Book of Better Homes".

Larkin Co. Inc.
Dept. 1040

BUFFALO, N. Y. Peoria, Ill. Chicago, Ill.



The Shipshape Home

(Continued from page 124)

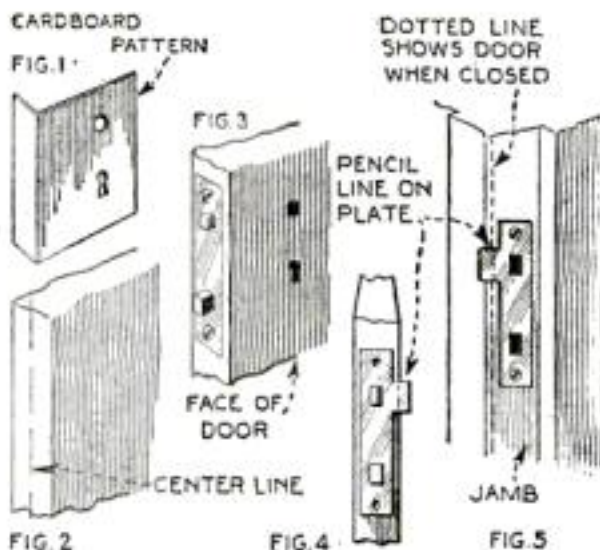
Fitting Mortise Locks

To FIT a mortise lock in a door is a problem that confronts at some time or other almost every home worker. It can be done quite easily and with perfect accuracy if the proper method is used.

Even for one door it is advisable to make a pattern, as shown in Fig. 1, from a part of the cardboard container in which the lock was packed. If a number of locks are to be installed, a pattern is, of course, a great time saver.

Next, locate the position of the lock by placing an escutcheon plate on the door. There is no standard height today, some authorities preferring a high handle and others a low handle. If undecided, arrange the escutcheon about 3 ft. above the floor. An inch or two either way will not matter, if it is desirable to place the knob so that it comes opposite the center of a rail or a panel.

Place the lock pattern on the door and mark both face and edge. Bore holes for



How to lay out and fit the mortise lock and its striking plate quickly and accurately

the handle and the top of the keyhole, using a 1/2-in. bit for the handle and a 5/16-in. bit for the keyhole.

Draw the center line on the edge of the door, as shown in Fig. 2, and with an 11/16 or 3/4-in. bit bore a series of holes the full depth of the lock. Place the holes as closely together as possible, and then clean out the wood with a long, narrow chisel and a wide one. Finish the keyhole with a compass or keyhole-saw. Insert the body of the lock in the mortise and mark around the faceplate with a sharp knife. Cut a recess within these lines sufficient to allow the faceplate to go in flush, as in Fig. 3.

Next, take the striking plate and place it on the lock, as in Fig. 4, and make a pencil mark on the projecting portion of the plate, in line with the face of the door. Take off the striking plate, close the door, and make another pencil mark along the face of the jamb in line with the edge of the door.

Now, place the striking plate on the jamb with the short pencil line on it in line with the pencil mark that has been drawn on the jamb, as in Fig. 5. This insures the striking plate's being in just the right position, provided a mark has also been made to fix its height correctly in relation to the latch and lock.

The striking plate is let into the jamb and nothing remains but to put on the handles and screw the escutcheons in place.



HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY if you lack
HANDICAPPED High School training.

You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

**FIT YOURSELF FOR A
BIG FUTURE** This course,

which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and meets all requirements of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people idle away fifty hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within two years. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

Check and mail the coupon NOW for full particulars and Free Bulletin.

American School

Dept. H-775

Drexel Ave. and 58th St., Chicago

American School

Dept. H-775, Drexel Ave. & 58th St., Chicago
Send me full information on the subject checked and how you will help me win success.

.....Architect	.....Lawyer
.....Building Contractor	.....Machine Shop Practice
.....Automobile Engineer	.....Photoplay Writer
.....Automobile Repairman	.....Mechanical Engineer
.....Civil Engineer	.....Shop Superintendent
.....Structural Engineer	.....Employment Manager
.....Business Manager	.....Steam Engineer
.....Cert. Public Accountant	.....Foremanship
.....Accountant and Auditor	.....Sanitary Engineer
.....Bookkeeper	.....Surveyor (& Mapping)
.....Draftsman and Designer	.....Telephone Engineer
.....Electrical Engineer	.....Telegraph Engineer
.....Electric Light & Power	.....High School Graduate
.....General Education	.....Fire Insurance Expert
.....Vocational Guidance	.....Wireless Radio
.....Business Law	.....Undecided

Name.....

Address.....

BUCHSTEIN'S FIBRE LIMB

soothing to your stump—
strong, cool, neat, light.
Easy payments.



Guaranteed 5 Years.
Send for Catalog Today.
P. BUCHSTEIN CO., 113 6th St., S., MINNEAPOLIS, MINN.

Volume! Clarity!! Delight!!!

with Kellogg Shielded Type Transformers



Kellogg Transformer

CORRECT audio frequency amplification is important in the satisfactory operation of loud speakers. Proper amplification (with KELLOGG transformers) results in a clear reproduction with minimum distortion and maximum volume.

Kellogg transformers are designed to overcome any defects of existing types and to furnish the very best of amplification.

They are built by the Kellogg Company, using magnet wire with the very best insulation, and of exactly the correct number of turns. The metal case is heavily enameled in maroon with a Kellogg Bakelite connecting rack. The laminated cores of

silicon steel are correctly proportioned and shaped for the most effective electrical field.

The primary and secondary binding posts are accessibly placed at the top of the transformers, and clearly marked so that there need be no error in connection. Every Kellogg transformer is thoroughly tested before leaving our plant and we guarantee the purchaser a product of exceptional efficiency.

No. 501—Ratio $4\frac{1}{2}$ —to 1—\$4.50 each
No. 502—Ratio 3 —to 1—\$4.50 each

KELLOGG SWITCHBOARD & SUPPLY COMPANY

Chicago

Columbus

Kansas City

Portland

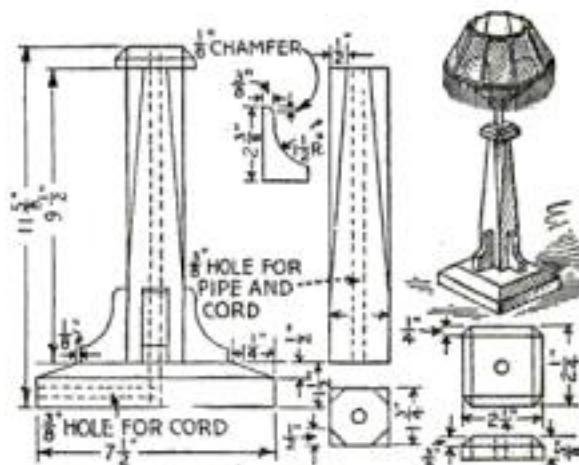
San Francisco

Craftsman Lamp for Library Table Is Easily Made

SIMPLE in design and not difficult to make, the oak lamp illustrated below is intended for use on a mission or "craftsman" library table. The shade may be of silk or parchment, or constructed of wood and stained glass in the home workshop. The lamp is proportioned for a two-light fixture.

The base is a $7\frac{1}{2}$ -in. square of $1\frac{1}{2}$ -in. quartered oak, with a $\frac{3}{8}$ -in. hole bored through the center. Another $\frac{3}{8}$ -in. hole is bored, preferably with a doweling jig, from one edge of the base to meet the central hole. The base is then chamfered, the ends being finished first to avoid chipping and splintering.

The post is $1\frac{3}{4}$ by $1\frac{3}{4}$ by $9\frac{1}{2}$ in. The center of one end is found by drawing diag-



Working details of the lamp with dimensions suitable for a two-light fixture

onal lines between the corners, and a $\frac{3}{8}$ -in. hole is bored the entire length. The chamfers, which run out $2\frac{3}{8}$ in. from the lower end, are then planed accurately.

The top is made by squaring a piece of $\frac{5}{8}$ -in. oak to $2\frac{1}{4}$ in., sawing off the corners and chamfering the edges. It is bored with a $\frac{3}{8}$ -in. hole. The four braces are cut from stock $\frac{3}{4}$ by $1\frac{1}{2}$ by $2\frac{3}{8}$ in. The curve is cut on a band or jigsaw, or with a coping saw, and the $\frac{1}{8}$ -in. chamfer planed as indicated.

All the parts should next be scraped and sandpapered. The post is fastened to the base by means of two No. 10 bright $2\frac{1}{2}$ -in. wood screws, so placed as not to block the cord hole. The top is fastened to the post with glue and finishing nails, and the holes are plugged with stick shellac. The braces are glued in place.

Any method of finishing may be used. Usually it is best to match as nearly as possible the finish of the table on which the lamp is to stand. The wire and fixtures may be obtained in any electrical store and will be found very easy to install.—KENNETH R. LAVOY, Hudson, N. Y.



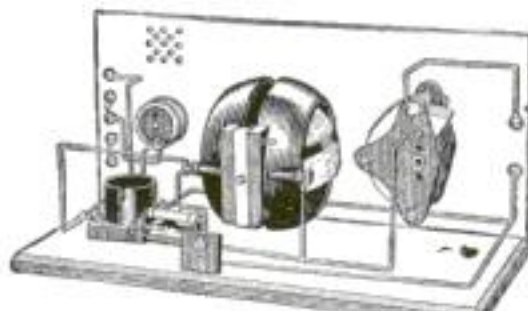
Make Your Own Radio Receiving Set

Enjoy the concerts, baseball scores, market reports, latest news, etc., as sent out by large broadcasting stations. This NEW copyright book, "EFFICIENT RADIO SETS," shows how to make INEXPENSIVE sets for receiving wireless broadcastings. Sent, postpaid for 25c. Address THE MACK CO., Dept. E., 9130 Baltimore Ave., Chicago.

Art Corner Your Pictures—Album
where you can keep them safe and enjoy them always.
Engel
5 Styles [Art Corners] 5 Colors
are on sale at Photo Supply and Album counters everywhere. They are the only quick, easy, artistic, no waste, no fold way to mount Kodak Prints. A dime brings 100 and samples to try. Write ENGEL MFG. CO. Dept. 58X 4771 N. Clark St., Chicago



ROYAL DIAMOND & WATCH CO.
170 Broadway—New York



You Can BUILD YOUR OWN Radio

with the Overland Circuit and the easy non-technical instructions ANYONE can assemble their own Radio Receiver. The Overland Circuit has proven this and has proven that it will

Cover a 2000 MILES Radius of 2000 MILES

which assures abundant radio entertainment regardless of where set is located.

Instruction Booklet and Complete parts for building the Overland Circuit Receiver as illustrated **\$11.50**

Instruction Booklet only; containing hook-up and wiring directions sent postpaid for 25c.

Address Mr. Jackson

OVERLAND RADIO
& EQUIPMENT CORPORATION
108 WEST 40TH ST., NEW YORK, N.Y.

FEATURES FOR NOVEMBER

How to make—

A combination library table and desk

A tuned radio frequency unit to add to your present receiving set

A Pullman play table for the children

A galloping merry-go-round

A better looking job, valuable shop kinks, and an unusual variety of workshop, "shipshape home," radio, and auto articles.

In This Issue

PAGE

Editorial	2
They Say	25
What Static Sparks Cost Us	27
By Raymond J. Brown	
High-Speed Movies—\$5000 a Second	29
Sky Leviathans of Tomorrow	30
By Rear-Admiral William A. Moffett	
A New Combination Tool	32
A Five-Ounce Pull Lifts Ton	32
Tiny Dry Cleaning Plant	32
Built-In Mailbox Saves Health and Time	32
Easily Detached Light Fixtures	32
An Automatic Pressure Kettle	32
A Gasoline Camp Stove	33
Tiny Microscope Magnifies 225 Times	33
Rake-Mower Trims Edges of Lawn	33
Supporting Small Objects before Camera	33
Wall Telephone Holder	33
Interesting People and Their Hobbies	34
Snuffing Out an Oilwell Fire	35
Are You Using All of Your Brains?	36
By James J. Walsh, Ph.D.	
New Baby Tub Lightens Work	38
Portable Radio without Aerial or Ground	38
Safety Platform for Window Washing	38
Single Lamp Changes Colors of Sign	38
World's First Aerial Bicycle Flies	39
Six Fuses in One Socket	39
Record Repeater Weighs Less than Ounce	39
Permanent or Temporary Paper Fastener	39
Our Silent Partners, the Plants	40
Article 8 in the series, "The Story of Man and His World," by E. E. Free, Ph.D. (Collaborating in this article with D. T. MacDougal, Ph.D., LL.D.)	
A Lower Berth for Everybody	43
Coin-in-the-Slot Radio	43
Revolving Sash Facilitates Window Cleaning	43
Auto Engine Serves as Sawmill	44
A Fresh-Air Cage for Baby	44
Simple Adjuster for Droplights	44
Quick-Change Screwdriver	44
Dustproof Two-Piece Overalls	44
Shoal Water Soundings with Light	45
Incubator Used in Cheesemaking	45
Night Flying Made Safe	45
Roof Railway for Cornice Work	46
Air Cushion Seats for Buses	46
Blowtorch Solders and Brands	46
A Flashlight for Bicycle Searchlight	47
Adjustable Window Shelf for Flowers	47
Nerve Splicing Is Achieved	47
A Mobile New Pump with Many Uses	47
Inventor Soars in 10-Pound Flying Machine	47
Is a New Ice Age Coming?	48
By Captain Donald B. MacMillan	
Tiny Models Illustrate Industrial Methods	50
New Railroad Ditcher Is Versatile	50
Milk-Bottle Carrier for Children	50
A Wireless Service Truck	50
Adjustable Propeller Controls Plane's Speed	51
Finger Sucking Prevented	51
Manikins Play Golf in New Game	51
Clamping Bridge Score Pad	51
Midget Locomotive of Ford Parts	51
Monobus May Bring Cheaper Rides	52
Sun-Dial as Accurate as a Watch	52
Tiny 18th Century Watches	52
Lie-Detector Reads the Eyes	52
Mastering the Science of Billiards	53
By Willie Hoppe	
World's Smallest Full-Grown Horse	55
New Wheel Wears Solid or Pneumatic Tires	55
Machine Cleans Tennis Balls	55
Armored Monster Once Roamed Texas	55
Burglar Wears Lamp-Glove	55
Midget Inboard Motor for Canoes	56
A Pocket Check Protector	56
Crane and Truck Combined	56
An Upright Campfire Broiler	56
A Novel Hacksaw Frame	56
A Filling Station for Pens	56
He Saved a Million Lives	57
Young Inventor Aids Uncle Sam	59
By H. H. Billany, Assistant U. S. Postmaster-General	
A Combination Wrench	59
Webbed Gloves for Swimmers	59
Tuned Radio Frequency Plus Regeneration	60
Radio Panels from Records	60
Radio Phones Tested by Phonograph	60
Radio for the Steeplejack	60
Radio to Join Ford Holdings	60
New Resistance Unit for "Peanut" Tubes	60
Around the Radio Circuits	61
By Jack Binn	
Largest Cut Stone Columns of Modern Times	63
Three-Wheeled Truck Reduces Costs	63
Mechanical Marvel Blows Bulbs	63
Useful Ideas for Home Convenience	64
Science Perfects a Mineral Lumber	65
How to Keep Linoleum-Covered Floors Clean	66
Farm Gate Swings on Wheel	66
New Wringer Adds Life to the Mop	66
High Chair Formed by Strap Attachment	66
Fly-Swatting Pistol	66
Cooking Better Food with Less Gas	67
Wild-Animal Hunters Save Millions	68
Can Your Jaws Lift Jack Dempsey?	69
By Arthur D. Black, M.D., D.D.S.	
Oiling and Greasing Your Car	70
Sliding Gear Simplifies Transmission	72
Know Your Car—Generator and Its Circuits	72
Automobile Sidelights Prevent Accidents	72
Hand Tire Pump Conserves Effort	72
More Service and Convenience from Your Car	73

The Home Workshop . 75
Better Shop Methods . 80



Rahe's

Complete AUTO and TRACTOR Training

Insure your future at 1/2 price



SUCCESS—does not require unusual ability. It does require TRAINING—CONCENTRATION on one thing and STICKING-TO-IT until YOU WIN.

Begin—Right Now—Today! Get into this tremendous Automotive Field—AND WIN. You can do it with our JOB METHOD. Learn the "RAHE WAY." There's always BIG MONEY for the TRAINED MAN. RAHE training means—Learning with YOUR HANDS and NOT BOOKS. A REAL JOB at REAL PAY is waiting for you. The "RAHE WAY" PAYS.

R. C. CARMEIN.

even ex-doctors and ex-lawyers, are to-day enjoying fine incomes. You can do the same for HALF PRICE if you act NOW.

Regular tuition price \$200 —
Now Cut To \$100

ACT TODAY

Remember this offer is good for a LIMITED TIME only. Hundreds of ambitious men have already taken advantage of this opportunity. Because of the fact we can only give proper instruction to a certain number of men, we are forced to extend this offer for only a short time. Get your enrollment in now.

LEARN BY DOING

Our method of teaching is practical. You work in the best equipped schools in the country under personal instruction of experts by actual work on all various types of engines. You get a thorough knowledge of all parts of motor cars, tractors, and stationary engines.

Rahe Auto & Tractor Schools

Dept. 2871

CHICAGO
4445 Grand Blvd.

Ninth and Walnut
CINCINNATI

FORDS run 34 Miles



(on Gallon of Gasoline)
Low Gear Seldom Used

With Air-Friction Carburetor

And we guarantee all other cars nearly double present mileage, power and flexibility, make hills on high formerly difficult on low. We carry models for any car, truck, tractor, marine or stationary engine. See our wonderful mileage guarantee—on gallon of gasoline for other cars.

Ford 34 mi.	Reo 24 mi.	Chevrolet . . 32 mi.
Buick 4 30 mi.	Chalmers . . 23 mi.	Maxwell (25) 30 mi.
Buick 6 24 mi.	Olds 6 23 mi.	Nash 6 23 mi.
Hudson 20 mi.	Paige 6 20 mi.	Lincoln 8 . . 17 mi.
Hupp 25 mi.	Oakland 6 . . 24 mi.	Stoddard 16 23 mi.
Dodge 28 mi.	Over'd 4 . . 32 mi.	Colo 8 17 mi.

If your car is not mentioned here send name and model for particulars and our guarantee on it. **AGENTS WANTED.**

SENT ON 30 DAY'S FREE TRIAL

You can drive any car in heaviest traffic without shifting gears. Starts off on high in any weather without priming or heating—no jerking or choking. No more foul-smelling plugs or carbon in cylinders. No leaking of gas into crank case. Try it 30 days on our guarantee of money back if not entirely satisfied. No strings to our guarantee. **YOU ARE THE JUDGE.** Anyone who can handle a wrench can attach it. No boring of new holes or changing of operating mechanism. Write today.

AIR-FRICTION CARBURETOR CO.
 17 Raymond Bldg. Dayton, Ohio, U. S. A.

\$100
 POSTPAID.

OUR "REGULAR" PACKAGE

200 Sheets
100 Envelopes

PRINTED WITH ANY
 NAME AND ADDRESS

Of all Christmas gifts, none is more tasteful than this. The original household note paper—used in better homes everywhere. Name and address neatly printed on 200 sheets and 100 envelopes in rich, dark blue ink. Size of sheet 5 x 7; envelopes to match. Stealing quality. Special facilities insure prompt service. Remit with order—or, if inconvenient at the moment, we will send C. O. D. West of Denver and outside U. S. add 10%. Money refunded if not satisfied.

THE AMERICAN STATIONERY CO.
 1835 Park Avenue Peru, Indiana
AMERICAN STATIONERY

St. Louis Man Discovers New Kind of Heat!



Amazing New Invention Does Away With Dirty Coal and Wood

No more fires to build, bank or watch—no more dirty, heavy coal to carry and lift—no more clouds of ashes to breathe, or back-breaking scuttles to empty—no more heating problems—no more cold rooms in Winter—no more suffering from lack of quick fires in uncertain Fall and Spring—no more worries about coal shortages, poor quality or high prices since this Wonderful New Invention.

For Every Heating Purpose



No coal—no wood. No dirt—no ashes. The Wonderful Oliver keeps rooms healthfully warm and cozy in coldest winter weather.



Oliver gives much or little heat—steady and even, for baking, broiling, frying or boiling—all at the turn of a valve. Better, cheaper, quicker.

BURNS 95% AIR—5% OIL

The Oliver Furnace Burner puts a roaring fire in hot water, steam or hot air plants. You turn it up or down, on or off by simply turning valve.



I need more Salesmen Agents and Distributors

Here is your opportunity to "cash in" on this Nation-wide sweep of oil. Housewives everywhere are clamoring for this amazing new burner. Oliver agents are making fortunes.

F. W. Bentley, of Phila., says, "Ye gods, some seller! I made \$215 today." J. Carnegie, So. Dakota, writes, "Making \$1000 a month." A. M. Russell, Conn., "Averaged \$660 for last six months." R. Berger made \$258 per week. Mrs. Selder, Kans., made \$100 a month, spare time only in her own home.

I want men and women of every type. If you want to earn \$40 to \$50 a week in spare time, write me. If you can give all your time as a salesman and want \$200 to \$250 a week, write me. If you can swing a whole territory and want \$5,000 to \$15,000 a year, wire me at my expense for sales plan and how you can get an exclusive franchise for your territory. But act at once if you want to "cash in" on this great new fuel idea.

Write today for sales plan and free book "New Kind of Heat". Address me personally, B. M. Oliver, President, at address shown above.

3 Times the Heat of Coal by simply turning valve

Here is the amazing new kind of heat that has ended forever the days of woman's slavery to household drudgery. Why should any woman give her best strength and energy in endless back-breaking servitude to a hot, mussy heater, cook stove or furnace? Why should anyone worry about coal shortages and high prices? No need for that now. The wonderful invention of Mr. B. M. Oliver, of St. Louis, in one minute turns any coal or wood burner into a modern, up-to-date gas stove. It gives as much or little heat as wanted by simply turning a valve.

Cheaper than coal or wood

Mr. Oliver calls his invention the Oliver Oil-Gas Burner, because it uses 95% air and only 5% coal oil (ordinary kerosene, the cheapest fuel there is) turning them into an actual gas that burns with an intensely hot, clean flame. No wicks, no smoke, no odor.

Fits all stoves—any kind or size

Mr. Oliver's wonderful invention is made in sixteen different models to fit any kind of cook stove, heating stove or furnace. No holes to drill, no bolts to fasten, no change whatever in your stove. Simply sets in the firebox. Easily slipped in, in one minute. Absolutely safe. It lasts a lifetime.

Oliver protects your home

You can absolutely depend upon your Oliver to heat your rooms in coldest Winter weather—it gives three times the heat of coal or wood. Physicians recommend it as the surest safeguard against chill, colds, pneumonia, influenza and other sickness. The even, steady, odorless and dustless heat protects your health. It saves its cost in cleaning bills alone. Every Fall we have a coal shortage which sends prices up sky-high. But you need not worry. Install this amazing new kind of heat and you can snap your fingers at coal shortages, poor quality or high prices.

Your Oliver burns the cheapest and most reliable fuel there is, kerosene.

No wonder housewives are clamoring for this wonderful device. No wonder we receive letters like these. Mrs. W. N. Spencer, of Connecticut, writes: "The Oliver in my heating stove works like magic. It is wonderful to have quick heat and no work." Mr. Elijah McCleave, of Virginia, says: "It works fine. All my friends want one. I will get their orders." A letter from Mr. S. K. Pedro, of South Carolina, says: "Beats all other burners seen in this county. A sensation." Mr. Geo. Flynn, of Michigan, writes: "It is cleaner, cheaper, hotter and steadier than coal or wood. Only cost me \$5.00 for two months."

Special Low Introductory Price

Now, once and for all, do away with household dirt and drudgery. End ashes, dirt, smoke, odor, chopping, shoveling, carrying dirty, heavy coal and wood. The Oliver in your stove, heater or furnace saves hours of work. Send immediately for the free attractive Booklet, "New Kind of Heat," telling all about this amazing new invention. Shows exactly how it works, how it is different from all other burners, how it will relieve you of the back-breaking work of coal and wood fires. And if you send immediately you will be in time to get a Special Low Introductory Price. Mr. Oliver is now making to the readers of this magazine. Even if you do not buy now you should not miss the opportunity to become entitled to this low price should you wish to buy later, by writing at once.

Mail Coupon for Free Offer

Don't send a cent. You can get this interesting Free Book and full information, without obligation. But don't delay. To get this big special offer you must act quick. Fill in and mail the coupon now.

OLIVER OIL-GAS BURNER

OLIVER OIL-GAS BURNER COMPANY

Oldest and largest manufacturers of oil gas burners in the world

2007-J Oliver Building St. Louis, Mo.

Canadian Distributors, 2007-J Oliver Bldg., Toronto, Ont.

OLIVER OIL-GAS BURNER Co., 2007-J Oliver Bldg., St. Louis, Mo.

Without obligation send me your FREE book "New Kind of Heat" and Special Low Price Introductory Offer. I am interested in the burner for a

☐ Coal Range ☐ Heating Stove ☐ Furnace
(Specify steam, hot air or hot water)

Name.....

Address.....

City.....State.....